PROJECT PLANNING MANUAL

HEAT PUMPS FOR HEATING AND DOMESTIC HOT WATER PREPARATION

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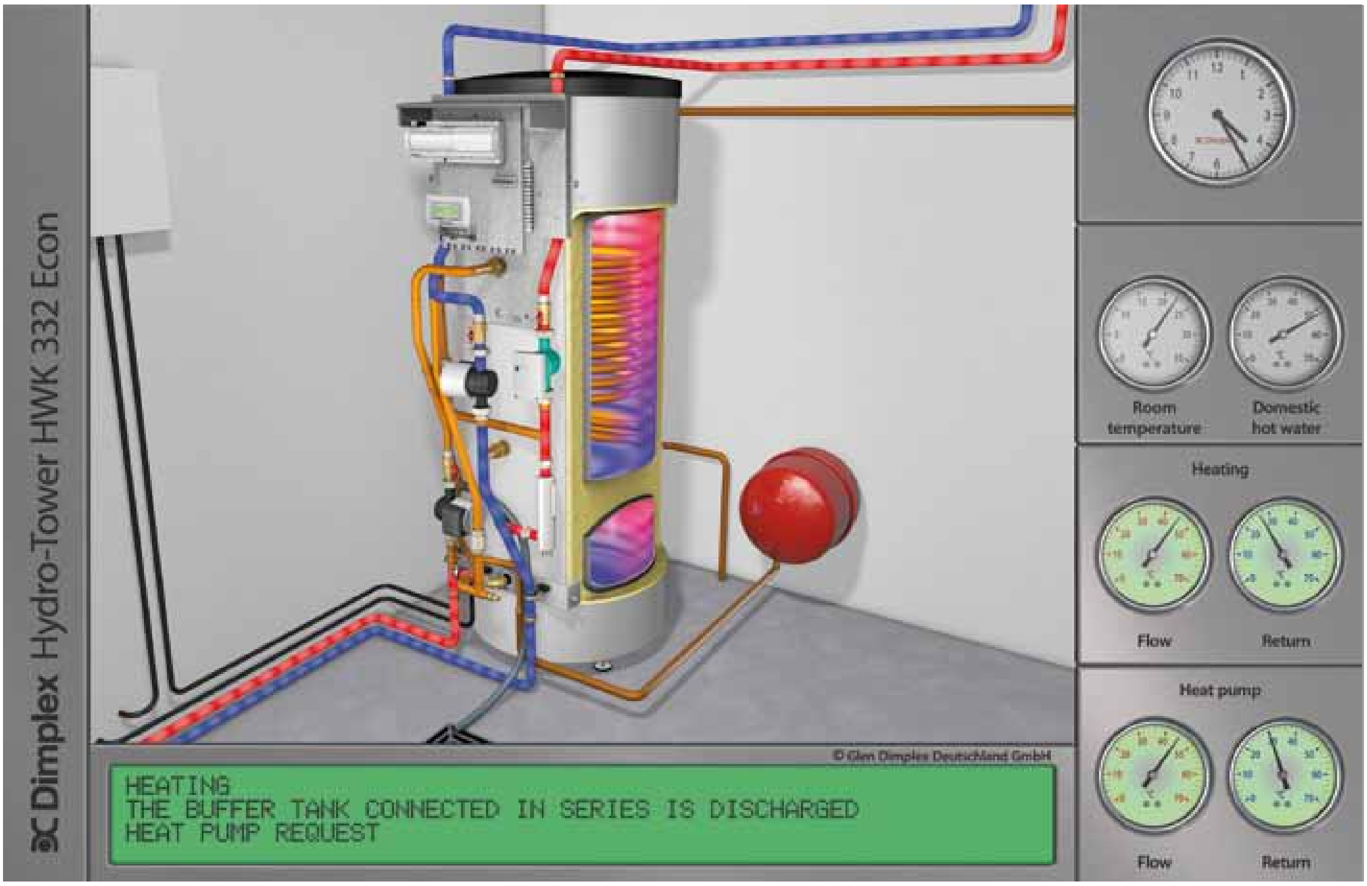

The dual differential pressureless manifold consists of two bypass pipes, each with one check valve. Flow through the first manifold is only maintained when the compressor is running. This reduces the pump runtimes and heat losses. The second manifold decouples the consumer circuit and, in combination with the buffer tank connected in series, ensures the minimum runtimes of the heat pump during low heat consumption.

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What are the benefits of a heat pump?

The fact that a large percentage of our energy supply is produced from fossil fuels poses serious consequences for our environment. Large quantities of pollutants, such as sulphur dioxide and nitrogen oxide, are released during combustion.

Domestic space heating with fossil fuels contributes significantly to pollutant emissions because extensive emission control measures, such as those used in modern power plants, cannot be carried out. Since our oil and gas reserves are limited, basing such a large percentage of our energy supply on fossil fuel sources also presents a serious problem.

The way electrical energy is generated will change in the future to favour more renewable or newly developed generation methods. You, too, can be a part of this development because electricity - as the energy of the future - is the operating energy of heat pumps.

What does a heat pump do?

A heat pump is a type of “transport device” that raises the temperature level of the heat that is freely available in the environment.

How does a heat pump convert low-temperature heat into high-temperature heat?

It extracts stored solar heat from the environment – ground, water (e.g. ground water) and air (e.g. outside air) – and transfers this, along with the operating energy, in the form of heat to the heating and domestic hot water circuit.

Heat cannot transfer from a cold body to a warm body on its own. Rather, it flows from a body with a higher temperature to a body with a lower temperature (Second Law of Thermodynamics). For this reason, the heat pump must raise the temperature of the thermal energy extracted from the environment using high-grade energy - e.g. electricity for the drive motor - to a level suitable for heating and domestic hot water preparation.

The heat pump actually works like a refrigerator. It uses the same technology, but with the opposite effect. Heat pumps extract heat from a cold environment which can then be used for heating and DHW preparation.

Glossary

Defrosting

Regular routine for removing frost and ice from evaporators on air-to-water heat pumps by applying heat. Air-to-water heat pumps with reversal of the direction of circulation feature the rapid and energy efficient defrosting properties required.

Bivalent-parallel operation

The bivalent operating mode (today this is normally bivalent-parallel operation) functions with two heat generators (two sources of energy), i.e. the heat pump covers the heating requirements up to a determined temperature limit, and is then backed up by a second energy source in parallel.

Bivalent/renewable operating mode

The bivalent renewable operating mode makes it possible to incorporate renewable heat sources such as wood or thermal solar energy. Should renewable energy sources be available, then the heat pump is blocked and the current heating, domestic hot water or swimming pool requirements are met by the renewable cylinder.

Carnot factor

The ideal reference cycle for all thermodynamic cycles is the so-called Carnot cycle. This (theoretical) model cycle gives maximum efficiency and - in comparison to a heat pump - the theoretically greatest possible COP. The Carnot factor is based solely on the temperature difference between the warm side and the cold side.

D-A-CH seal of approval

Certificate for heat pumps in Germany, Austria and Switzerland which fulfil specific technical requirements, have a 2-year warranty, ensure the availability of spare parts for 10 years and whose manufacturers offer a comprehensive customer service network. The seal of approval also certifies that a line of heat pumps has been manufactured as a series.

EnEV

The Ordinance for Energy-Saving Thermal Insulation and Energy-Saving Building Installation Technology (EnEV) [German: Verordnung über energiesparenden Wärmeschutz und energiesparende Anlagentechnik bei Gebäuden (Energieeinsparverordnung EnEV)] has been in force since February 1, 2002. It supersedes the Thermal Insulation and Heating System Ordinance. In addition to specifying standards for new buildings, this ordinance also sets deadlines for exchanging outdated heating systems.

Utility company shut-off times

Local utility companies offer special tariffs for heat pumps, provided that the power supply can be shut off by the utility company at certain times of the day. The power supply can, for example, be interrupted for 3 x 2 hours within a 24-hour period. This means that the daily heat output (quantity of heat produced daily) must be produced within the period of time in which electrical energy is available.

Expansion valve

Heat pump component between the liquefier and the evaporator for reducing the condensation pressure to match the respective evaporation pressure determined by the evaporation temperature. The expansion valve also controls the quantity of refrigerant to be injected in relation to the respective evaporator output.

Limit temperature / bivalence point

The outside temperature at which the 2nd heat generator is additionally connected in mono energy (electric heating element) and bivalent-parallel operation (e.g. boiler) as required, and both modes of operation jointly provide the house with heat.

Seasonal performance factor

The seasonal performance factor is defined as the ratio of the quantity of electrical energy supplied in one year to the amount of thermal energy extracted by the heat pump system. It is based on a particular heating system taking the respective design of that system into consideration (temperature level and temperature difference) and is not the same as the coefficient of performance.

Annual effort figure

The annual effort figure is exactly the opposite of the performance factor. The annual effort figure indicates what input (e.g. electrical energy) is required to achieve a defined benefit (e.g. heating energy). The annual effort figure also includes the energy for the auxiliary drives. VDI Guideline 4650 is used to calculate the annual effort figure.

Refrigeration capacity

Heat flow which is extracted from the environment by the evaporator of a heat pump. The heat output of the compressor is calculated from the electrical power consumption and refrigerating capacity applied.

Refrigerant

The working medium used in a refrigerating machine or heat pump is called a refrigerant. It can be characterised as a fluid which is used for transferring heat in a refrigerating system. Refrigerants absorb heat at a low temperature and pressure and emit heat at a higher temperature and pressure. Refrigerants which are non-poisonous and non-inflammable are designated as safety refrigerants.

COP

The ratio between the absorbed electrical energy and the heat output emitted by the heat pump is expressed by the coefficient of performance (COP). This is measured under standardised boundary conditions in a laboratory according to EN 255 / EN 14511 (e.g. for air A2/W35, A2= air intake temperature +2 °C, W35= heating water flow temperature 35 °C). A COP of 3.2, for example, means that 3.2 times the consumed electrical energy is available as usable heat output.

lg p,h diagram

Graphic representation of the thermodynamic properties of a working medium (enthalpy, pressure, temperature).

Mono energy operation

In principle, the mono energy mode of operation is a bivalent-parallel mode of operation utilising only one source of energy, normally electricity. The heat pump supplies a large part of the required heat output. An electric heating element supplements the heat pump on those few days during the year with extremely low outside temperatures.

Air-to-water heat pumps are normally dimensioned for a limit temperature (also known as the bivalence point) of approx. -5 °C.

Monovalent operation

In this operating mode, the annual heat consumption of the building is completely covered (100%). This type of application should be preferred wherever possible.

Brine-to-water and water-to-water heat pumps are normally operated in monovalent mode.

Buffer tank

The installation of a heating water buffer tank is basically recommended to lengthen the runtimes of the heat pump during periods of reduced heating demand.

A buffer tank is absolutely essential for air-to-water heat pumps to guarantee a minimum runtime of 10 minutes during defrosting (regular routine for removing frost and ice from the evaporator).

Sound

A distinction is made between two types of sound, airborne sound and solid-borne noise. Airborne sound is sound which spreads through the air. Solid-borne noise spreads through solid materials or fluids and is also partially emitted as airborne sound. The audible sound range is between 16 and 16,000 Hz.

Sound pressure level

The sound pressure level, measured in the surroundings, is not a machine-specific quantity, but a quantity dependent on the test distance and the test location.

Sound power level

The sound power level is a machine-specific and comparable parameter for the acoustic output emitted by a heat pump. Both the sound emission level to be expected at particular distances and the acoustic environment can be estimated. The standard treats the sound power level as a characteristic noise value.

Brine / brine fluid

Frost-proof mixture consisting of water and a glycol-based antifreeze concentrate for use in ground heat collectors and borehole heat exchangers.

Evaporator

Heat exchanger of a heat pump in which a heat flow is extracted by evaporation of a working medium of the heat source (air, ground water, ground) at a low temperature and with a low pressure.

Compressor

Machine for the mechanical conveyance and compression of gases. The pressure and temperature of the refrigerant are raised considerably by means of compression.

Liquefier

Heat exchanger of a heat pump in which the heat flow is emitted by liquefaction of a working medium.

Heat consumption calculation

Accurate dimensioning is essential for heat pump systems because overdimensioned systems increase energy costs and have a negative effect on efficiency.

The heat consumption is calculated on the basis of national standards:

The specific heat consumption (W/m^2) is multiplied by the living space area to be heated. The result is the total heat consumption including both the transmission heat consumption and the ventilation heat consumption.

Heating system

The heating system has a significant influence on the efficiency of the heat pump heating system and should function at the lowest possible flow temperatures. It consists of the system used for conveying the heat transfer medium from the warm side of the heat pump to the heat consumers. In a detached house, for example, it consists of the piping for heat distribution, the low-temperature heating system and/or the radiators, and includes all auxiliary equipment as well.

Heat pump system

A heat pump system consists of the heat pump and the heat source system. Heat source systems for brine-to-water and water-to-water heat pumps must be separately tapped.

Heat pump heating system

Complete system consisting of the heat source system, the heat pump and the heating system.

Heat source

Medium from which heat is extracted with the heat pump.

Heat source system

System for the extraction of heat from a heat source and the conveyance of the heat transfer medium between the heat source and the heat pump including all auxiliary equipment.

Heat transfer medium

Liquid or gaseous medium (e.g. water, brine or air) with which heat is conveyed.

Wall heating

Wall heating has water flowing through it and functions like a large radiator. It has the same advantages as underfloor heating. As a rule, a temperature of 25 °C to 28 °C is sufficient for the heat transfer which is mainly supplied to the rooms in the form of radiant heat.

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Symbols

Size	Symbol	Unit	Additional units (definition)
Mass	m	kg	
Density	ρ	kg/m^3	
Time	t	s h	1 h = 3600 s
Volume flow	$\dot{V}$	m^3/s	
Mass flow	$\dot{M}$	kg/s	
Force	F	N	$1 N = 1 kg m/s^2$
Pressure	p	N/m^2; Pa	$1 Pa = 1 N/m^2$ $1 bar = 10^5 Pa$
Energy, work, heat (quantity)	E, Q	Y kWh	$1 J = 1 Nm = 1 Ws = 1kg m^2/s^2$ 1 kWh = 3600 kJ = 3.6 MJ
Enthalpy	H	Y	
(Heat) output **Heat flow**	P, $\dot{Q}$	W kW	1 W = 1 J/s = 1 Nm/s
Temperature	T	K °C	Absolute temperature, temperature difference Temperature in °Celsius
Sound power **Sound pressure**	L_{WA} L_{PA}	dB(re 1pW) dB(re 20µPa)	Sound pressure level, sound power level
Efficiency	η	-	
COP	ε (COP)	-	Output figures
Performance factor	ß		e.g. seasonal performance factor
Specific heat content	c	J/(kg K)	

Greek alphabet

α	Α	alpha	ι	Ι	iota	ρ	Ρ	rho
β	Β	beta	κ	Κ	kappa	σ	Σ	sigma
γ	Γ	gamma	λ	Λ	lambda	τ	Τ	tau
δ	Δ	delta	μ	Μ	mu	υ	Υ	ypsilon
ε	Ε	epsilon	ν	Ν	nu	φ	Φ	phi
ζ	Ζ	zeta	ξ	Ξ	xi	χ	Χ	chi
η	Η	eta	ο	Ο	omicron	ψ	Ψ	psi
ϑ	θ	theta	π	Π	pi	ω	Ω	omega

Energy content of various types of fuel

Fuel	Heating value[1] H_i (H_u)	Calorific value[2] H_s (H_o)	max. CO_2 emission (kg/kWh) based on	
			Heating value	Calorific value
Coal	8.14 kWh/kg	8.41 kWh/kg	0.350	0.339
Heating oil EL	10.08 kWh/l	10.57 kWh/l	0.312	0.298
Heating oil S	10.61 kWh/l	11.27 kWh/l	0.290	0.273
Natural gas L	8.87 kWh/m_n^3	9.76 kWh/m_n^3	0.200	0.182
Natural gas H	10.42 kWh/m_n^3	11.42 kWh/m_n^3	0.200	0.182
Liquid gas (propane) (ρ = 0.51 kg/l)	12.90 kWh/kg 6.58 kWh/l	14.00 kWh/kg 7.14 kWh/l	0.240	0.220
Current	---	---	0.200	

1. The heating value Hi (formerly H_u)
   The heating value H_i (also called the lower heating value) is the thermal energy which is released during total combustion when the steam produced during combustion is discharged without being utilised.
2. Calorific value Hs (previously H_o)
   The calorific value H_S (also called the upper heating value) is the thermal energy which is released during total combustion when the steam produced during combustion condensates so that the heat of evaporation is thus available for use.

Conversion tables

Energy units

Unit	J	kWh	kcal
1 J = 1 Nm = 1 Ws	1	$2.778 * 10^{-7}$	$2.39 * 10^{-4}$
1 kWh	$3.6 * 10^{6}$	1	860
1 kcal	$4.187 * 10^{3}$	$1.163 * 10^{-3}$	1

Specific heat capacity of water: 1.163 Wh/kg K = 4.187 J/kg K = 1 kcal/kg K

Power units

Unit	kJ/h	W	kcal/h
1 kJ/h	1	0.2778	0.239
1 W	3.6	1	0.86
1 kcal/h	4.187	1.163	1

Pressure

bar	Pascal	Torr	Water column
1	100,000	750 mm HG	10.2 m

Length

Metre	Inch	Foot	Yard
1	39.370	3.281	1.094
0.0254	1	0.083	0.028

Powers

Prefix	Abbreviation	Denotation	Prefix	Abbreviation	Denotation
Deca	da	10^{1}	Deci	d	10^{-1}
Hecto	h	10^{2}	Centi	c	10^{-2}
Kilo	k	10^{3}	Milli	m	10^{-3}
Mega	M	10^{6}	Micro	µ	10^{-6}
Giga	G	10^{9}	Nano	n	10^{-9}
Tera	T	10^{12}	Pico	p	10^{-12}
Peta	P	10^{15}	Femto	f	10^{-15}
Exa	E	10^{18}	Atto	a	10^{-18}

1 Selection and design of heat pumps

1.1 Design of existing heating systems – heat pumps for the renovation market

1.1.1 Heat consumption of the building to be heated

In the case of existing heating systems, the heat consumption of the building to be heated must be recalculated because the heat output of the existing boiler cannot serve as a gauge for the actual heat consumption. Boilers are - as a rule - overdimensioned and therefore produce a heat pump output which is too large. The actual heat consumption is calculated according to the respective national standards (e.g. EN 12831). However, an approximate estimate can be made on the basis of the existing energy consumption of the living space to be heated and the specific heat consumption.

The approximate heat consumption can be determined as follows:

Calculation for oil:

$$QN = \frac{\mathrm{Ba} \cdot \mathrm{eta} \cdot \mathrm{Hu}}{Bvh}$$

Calculation for gas:

$$QN = \frac{\mathrm{Ba} \cdot \mathrm{eta}}{Bvh}$$

Simplified calculation:

$$QN = \frac{\mathrm{Ba}}{250}$$

with:

- QN = heat consumption building
- Ba = annual consumption gas (in kWh) or oil (in l)
- eta = degree of efficiency gas or oil heating
- Bvh = number of full usage hours per year
- Hu = heating value heating oil (in kWh/l)

The number of full usage hours per year depends on the building type and climate region. The following table shows the number of full usage hours per year for different building types in accordance with VDI 2067.

Building type	Full usage hours (h/a)
Detached house	2,100
Apartment building	2,000
Office building	1,700
Hospital	2,400
School (single-shift operation)	1,100
School (multiple-shift operation)	1,300

Table 1.1: Number of full usage hours per year for different building types

The specific heat consumption for detached and semi-detached homes built between 1980 and 1994 is around 80 W/m^2. For homes built before 1980 in which no additional thermal insulation measures have been carried out, it is between 100 W/m^2 and 120 W/m^2. In existing systems, the actual state of the system must be taken into consideration.

i NOTE

When selecting a heat pump the heat consumption of the building must be calculated according to the country-specific standard (e.g. EN 12831). The selection of a heat pump based on previous energy consumption values or guidelines for the building's heat consumption is not permitted. The heat pump can be significantly over- or underdimensioned in this case.

1.1.2 Determining the required flow temperature

In most oil and gas boiler systems, the thermostat is set to a temperature ranging from 70 °C to 75 °C. As a rule, this high temperature is only required for preparing domestic hot water. Downstream regulator systems within the heating system, such as mixing and thermostat valves, prevent the building from overheating. If a heat pump is retrofitted, it is imperative to calculate the actual flow and return temperatures required, so that the correct renovation measures can be determined.

There are two ways of doing this.

a) **Heat consumption calculation and heat consumption per room are known.**
The output according to the respective flow and return temperatures is listed in the heat output tables for the radiators (see *Table 1.2 on page 11*). The room for which the highest temperature is required determines the maximum flow temperature in the heating system.

Cast iron radiators										
Height	mm	980			580			430		280
Depth	mm	70	160	220	110	160	220	160	220	250
Heat output per element in W, at mean water temperature T_m	50 °C	45	83	106	37	51	66	38	50	37
	60 °C	67	120	153	54	74	97	55	71	55
	70 °C	90	162	206	74	99	129	75	96	74
	80 °C	111	204	260	92	126	162	93	122	92

Steel radiators										
Height	mm	1,000			600			450		300
Depth	mm	110	160	220	110	160	220	160	220	250
Heat output per element in W, at mean water temperature T_m	50 °C	50	64	84	30	41	52	30	41	32
	60 °C	71	95	120	42	58	75	44	58	45
	70 °C	96	127	162	56	77	102	59	77	61
	80 °C	122	157	204	73	99	128	74	99	77

Table 1.2: Heat output of radiator elements (at a room temperature of t_i=20 °C, according to DIN 4703)

b) **Experimental determination of the heating period (see Fig. 1.1 on page 11)**
The flow and return temperatures are continually reduced during the heating period with the thermostat valves fully open until a room temperature of approx. 20–22 °C is reached. Once the desired room temperature has been reached, the current flow and return temperatures plus the outside temperature are noted and entered in the diagram shown below. The **actually** required temperature level (low, medium, or high temperature) can be read from the entered value using this diagram.

i NOTE

Carrying out a hydraulic alignment can reduce the maximum required flow temperature!

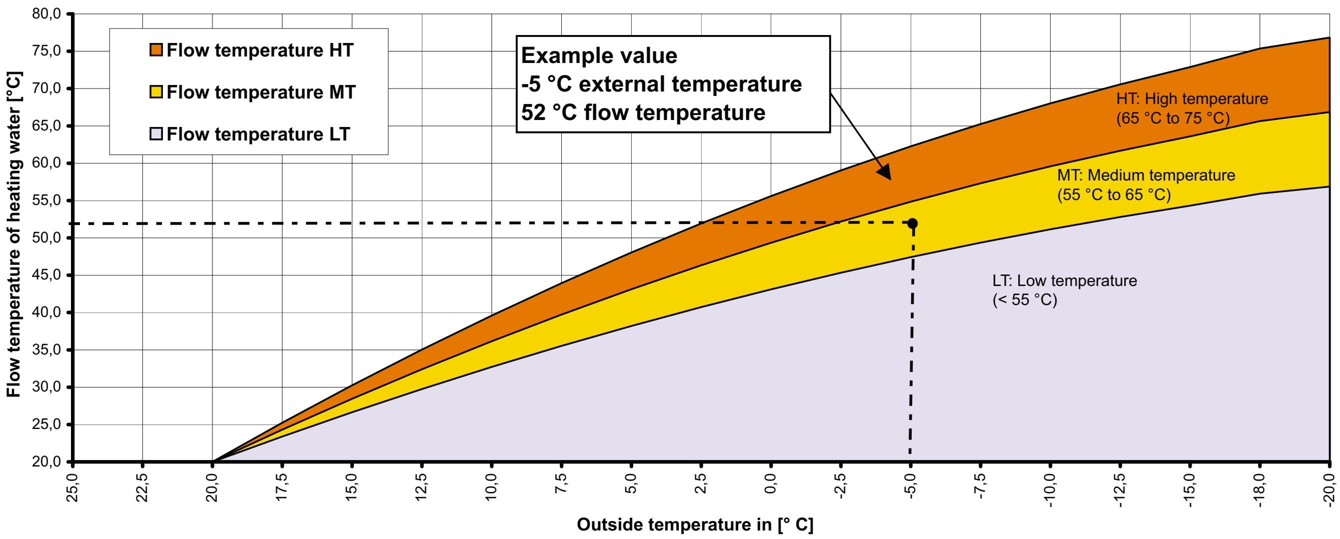


Fig. 1.1: Diagram for experimental determination of the actually required system temperatures

1.1.3 Which renovation measures must be carried out for energy-saving heat pump operation?

Low temperature
Flow temperature for all rooms max. 55 °C

If the required flow temperature is below 55 °C, no additional measures are required. Any low-temperature heat pump for flow temperatures up to 55° C can be used.

Medium temperature
Flow temperature in some rooms higher than 55 °C

If the required flow temperature is only higher than 55 °C in some rooms, measures must be taken to reduce the required flow temperature. In this case, only the radiators in the affected rooms are replaced to enable the use of a low-temperature heat pump.

Medium temperature
Flow temperatures in almost all rooms between 55 °C and 65 °C

If temperatures between 55 °C and 65 °C are required in almost all rooms, the radiators in most of the rooms must be replaced. As an alternative, the decision can be made to use a medium-temperature heat pump instead.

High temperature
Flow temperatures in almost all rooms between 65 °C and 75 °C

If flow temperatures ranging from 65 °C to 75 °C are required, the complete heating system must be converted or adapted. If it is not possible or not desired to carry out such a conversion, a high-temperature heat pump must be installed instead.

A reduction in heat consumption achieved by

- replacing windows
- reducing ventilation losses
- insulating ceiling spaces, attics and/or facades

yields savings when retrofitting with a heat pump in four different ways.

a) By reducing the heat consumption, a smaller and therefore cheaper heat pump can be installed.

b) A lower heat consumption leads to a reduction in the annual energy consumption which must be met by the heat pump.

c) The lower heat consumption can be met with reduced flow temperatures, which therefore improves the seasonal performance factor.

d) Improved thermal insulation leads to an increase in the mean surface temperatures of the space-enclosing surfaces. As a result, the same degree of comfort can be achieved at lower room temperatures.

Example:

A house with a heat consumption of 20 kW and an annual energy consumption for heating of approx. 40,000 kWh is heated with a domestic hot water heating system with a flow temperature of 65 °C (return 50 °C). By subsequently carrying out thermal insulation measures, the heat consumption can be cut by 25% to 15 kW and the annual energy demand for heating can be cut to 30,000 kWH.

In this way, the average flow temperature can be lowered by approx. 10 K, reducing the energy consumption by a further 20-25%. The total savings in energy costs when implementing a heat pump heating system amount to approx. 44%.

i NOTE

The following applies for all heat pump heating systems:
Every 1°C reduction in the flow temperature yields a saving in energy consumption of approx. 2.5 %.

1.1.4 Choice of heat source (renovation)

It is rarely possible to install a ground heat collector, borehole heat exchanger or well system in the renovation market for existing houses and landscaped gardens. In most cases, the outside air is the only possible heat source.

Air is available everywhere as a heat source, and can be used at any time without requiring approval. The seasonal performance factors which are to be expected are lower than is the case when either water or geothermal systems are implemented. At the same time, the costs for tapping the heat source system are lower.

Refer to the relevant chapters for further information on how to dimension heat source systems for brine-to-water and water-to-water heat pumps.

1.2 Heat pumps for new systems

1.2.1 Calculating the heat consumption of the building

The maximum hourly heat consumption $\dot{Q}_h$ is calculated according to the respective national standards. It is possible to approximately estimate the heat consumption using the living space A (m^2) that is to be heated:

$$\underset{[kW]}{Heat\ consumption} = \underset{[m^2]}{Heated\ area} \cdot \underset{[kW/m^2]}{Specific\ heat\ consumption}$$

$\dot{q}$ = 0.03 kW/m^2	Low-energy house
$\dot{q}$ = 0.05 kW/m^2	According to thermal insulation ordinance 95 and/or the EnEV minimum insulation standard
$\dot{q}$ = 0.08 kW/m^2	For a house with normal thermal insulation (houses built from approx. 1980 onwards)
$\dot{q}$ = 0.12 kW/m^2	For older walls without special thermal insulation

Table 1.3: Estimated specific heat consumption values

1.2.2 Determining the flow temperatures

When designing the heat distribution system of a heat pump heating system, it should be borne in mind that the required heat consumption should be assigned on the basis of the lowest possible flow temperatures, because every 1 °C reduction in the flow temperature yields a saving in energy consumption of approx. 2.5 %. Extensive heating surfaces, e.g. underfloor heating, are ideal. The required flow temperature should generally be 55 °C max. to enable the use of low-temperature heat pumps. If higher flow temperatures are necessary, medium or high-temperature heat pumps must be used (Chapt. 1.1.3 on page 12).

1.2.3 Choice of heat source

The decision as to whether air, brine (ground heat collector, borehole heat exchanger) or water (well system) should be used as the heat source should be made based on the following factors.

a) **Investment costs**
In addition to the costs for the heat pump and the heating system (radiators and circulation pump), the investment costs are heavily influenced by the costs of tapping the heat source.

b) **Operating costs**
The expected seasonal performance factors of the heat pump heating system have a large influence on the operating costs. These are primarily affected by the heat pump type, the average heat source temperature and the required heating flow temperatures.

⚠ ATTENTION!

When selecting a heat pump the heat consumption of the building must be calculated according to the country-specific standard (e.g. EN 12831). The selection of a heat pump based on previous energy consumption values or guidelines for the building's heat consumption is not permitted. The heat pump can be significantly over- or underdimensioned in this case.

i NOTE

The seasonal performance factors which can be expected for air-to-water heat pumps are lower than for water and geothermal systems. However, the costs for tapping the heat source system are also lower.

1.3 Additional power requirements

1.3.1 Utility company shut-off times

Most utility companies offer special agreements with a lower electricity tariff if heat pumps have been installed. According to the German Federal Tariff Ordinance, the utility company may offer such an agreement if it is able to switch off and block heat pumps at times of peak demand in the supply network.

The heat pump is then no longer available for heating the house during these shut-off times. Therefore, surplus energy must be produced during the periods in which the heat pump is not available for use. Hence, the heat pump should be overdimensioned to allow for this.

Utility company shut-off times normally last up to 4 hours a day, which must be allowed for with a factor of 1.2.

Dimensioning

The calculated heat consumption values for heating and domestic hot water preparation should be added together. Unless a second heat generator is additionally used during the shut-off time, the sum of the heat consumption values must be multiplied by the dimensioning factor f:

Basis of the calculation:

$$f = \frac{24h}{Release\ period} = \frac{24h}{24h - Release\ period}$$

Blocking time (total)	Dimensioning factor
2 h	1.1
4 h	1.2
6 h	1.3

Table 1.4: Dimensioning factor f for taking shut-off times into consideration

The existing heat storage capacity of solidly built houses, particularly those with underfloor heating, is normally sufficient to also bridge longer shut-off times with only a small loss of comfort, so that it is not necessary to use a second heat generator (e.g. boiler). However, an increase in output of the heat pump is necessary because of the need for reheating the storage mass.

1.3.2 Domestic hot water preparation

Domestic hot water consumption in buildings depends heavily on usage. For normal comfort requirements, domestic hot water consumption lies at between 80 and 100 litres per person, per day, based on a domestic hot water temperature of 45 °C. In this case, a heat output for domestic hot water preparation of 0.2 kW per person must be taken into account.

i NOTE

The maximum possible number of persons should be assumed when dimensioning, and any special usage (e.g. a spa bath) should also be taken into consideration.

If the design point of the heat pump means that domestic hot water preparation takes place via a flange heater, the additional energy consumption for domestic hot water preparation does not have to be added to the heating consumption.

Circulation pipes

Circulation pipes increase the line-side heat consumption of the domestic hot water heating. This increase in consumption depends on both the length of the circulation pipes and the quality of the pipe insulation, and must be taken into consideration accordingly. If a circulation system cannot be dispensed with because of long pipe runs, a circulation pump should be used that can be activated by a flow sensor according to need. The heat consumption for a circulation pipe can be considerable.

i NOTE

To be in compliance with Paragraph 12 (4) of the German Energy Efficiency Ordinance, circulation pumps in domestic hot water systems must be equipped with an automatic switch-on/switch-off mechanism.

1.3.3 Swimming pool water heating

Outdoor swimming pool

The heat consumption for heating the water in an outdoor swimming pool depends strongly on the respective usage.

In terms of size, it can easily be the same as the heat consumption of a house - and in such cases must be calculated separately.

However, if heating is only carried out in the summertime (period not requiring heating), the heat consumption can be ignored in certain cases.

An approximate estimation of the heat consumption is dependent on the windage factor, the temperature of the pool, the climatic conditions, the periods of use and whether or not the pool has a cover.

	Water temperature		
	20 °C	24 °C	28 °C
With cover[1]	100 W/m^2	150 W/m^2	200 W/m^2
without cover sheltered location	200 W/m^2	400 W/m^2	600 W/m^2
without cover partially sheltered location	300 W/m^2	500 W/m^2	700 W/m^2
without cover unsheltered location (subject to high winds)	450 W/m^2	800 W/m^2	1,000 W/m^2

1. Reduced values for pools with a cover only refer to private swimming pools used on average up to 2 hrs per day.

Table 1.5: Reference values for the heat consumption of outdoor swimming pools used between May and September

For initially heating the pool to a temperature of over 20 °C, the quantity of thermal energy required is approx. 12 kWh/m^3 pool volume. Heating-up periods ranging from one to three days are required depending on the size of the pool and the output of the installed heating system.

Indoor swimming pool

- Space heating
  Space heating is generally carried out using radiators or underfloor heating and/or a heating register in the dehumidification/ventilation system. In both cases, it is necessary to calculate the heat consumption - according to the system installed.
- Swimming pool water heating
  The heat consumption depends on the pool temperature, the temperature difference between the pool temperature and the room temperature, and the pool usage.

Room temperature	Water temperature		
	20 °C	24 °C	28 °C
23 °C	90 W/m^2	165 W/m^2	265 W/m^2
25 °C	65 W/m^2	140 W/m^2	240 W/m^2
28 °C	20 W/m^2	100 W/m^2	195 W/m^2

Table 1.6: Reference values for the heat consumption of indoor swimming pools

These outputs can be reduced by up to 50% for private swimming pools with a cover that are used for a maximum of 2 hours per day.

i NOTE

When using a brine-to-water heat pump for swimming pools, the heat source must be designed for the higher number of hours per year that the heat pump is operated to its full potential.

1.3.4 Determining the heat pump output

1.3.4.1 Air-to-water heat pump (mono energy operation)

Air-to-water heat pumps are primarily operated in mono energy systems. The heat pump should fully meet the heat consumption down to an outside temperature (bivalence point) of approx. -5 °C. In the event of very low temperatures and high heat consumption, a second, electrically operated heat generator will be activated.

In the case of mono energy systems, dimensioning of the heat pump output has a particularly strong influence on the level of the investment and the annual heating costs. The higher the heat pump output, the greater the investment costs of the heat pump and the lower the annual running costs for heating.

Experience has shown that a heat pump should be selected which intersects the heating characteristic curve for a limit temperature (bivalence point) of approx. -5 °C.

According to the DIN 4701 T10 standard, this yields a 2% ratio for the second heat generator (e.g. heating element) when operated as a bivalent-parallel system.

Fig. 1.2 on page 15 shows the annual characteristic curve of the outside temperature in Essen, Germany. According to this, there are less than 10 days in the year with an outside temperature under -5 °C.

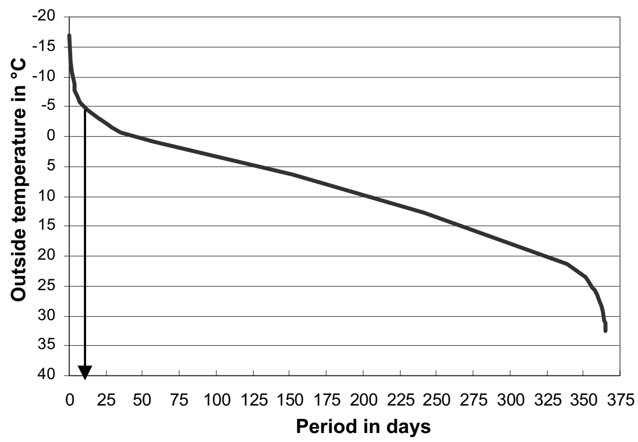


Fig. 1.2: Annual characteristic curve: Number of days on which the outside temperature is below the specified value

Example for *Table 1.7 on page 15*:

A bivalence point of -5 °C yields a heat pump proportion of approx. 98% for a bivalent-parallel (mono energy) mode of operation.

Bivalence point [°C]	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5
Coverage ratio [-] for biv.-paral. operation	1.00	0.99	0.99	0.99	0.99	0.98	0.97	0.96	0.95	0.93	0.90	0.87	0.83	0.77	0.70	0.61
Coverage ratio [-] for biv.- altern. operation	0.96	0.96	0.95	0.94	0.93	0.91	0.87	0.83	0.78	0.71	0.64	0.55	0.46	0.37	0.28	0.19

Table 1.7: Coverage ratio of the heat pump of a mono energy system or a system operated as a bivalent system according to bivalence point and mode of operation (source: Table 5.3-4 DIN 4701 T10)

1.3.4.2 Design example for an air-to-water heat pump

The heat pump is dimensioned on the basis of the heat consumption of the building in relation to the outside temperature (simplified as a straight line) in the heat output diagram and the heat output curve of the heat pump. The building's heat consumption in relation to the outside temperature is entered on the basis of the selected room temperature (corresponding to the outside temperature point 1) on the horizontal axis (x-axis) for the calculated heat output (point 2) for the standard outside temperature according to national standards.

Building data:

- Mono energy mode of operation
  (Heat pump with electric heating element)
- Heating system with a maximum flow temperature of 35 °C
- Shut-off time 2 hours
  (factor f from Tab. 1.3 on p. 13)
- Heat consumption heating **9.0 kW**
- Heat consumption domestic hot water preparation **1.0 kW**

Calculation:
required heat output of the heat pump

= (heat consumption heating + heat consumption domestic hot water preparation) x factor f

= (9.0 kW + 1.0 kW) x 1.1 = **11.0 kW**

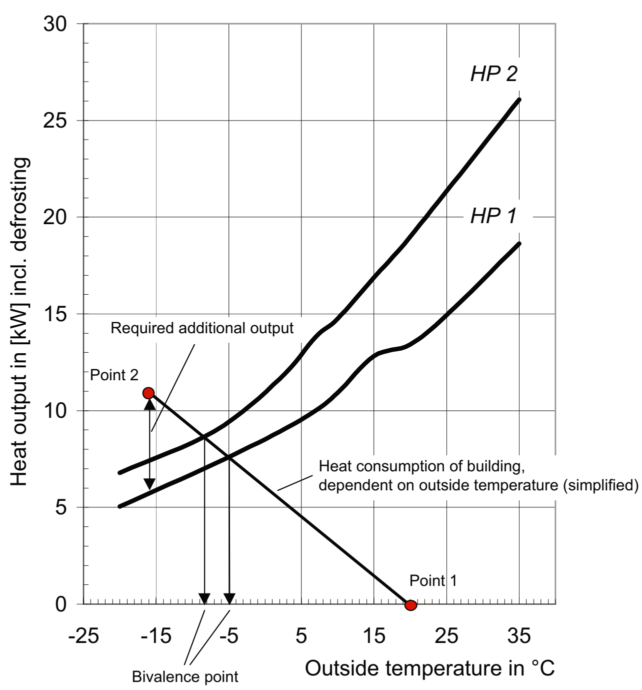


Fig. 1.3: Heat output curves for two air-to-water heat pumps with different heat outputs for flow temperatures of 35 °C and a building heat consumption in relationship to the outside temperature

The approach is illustrated by the example from Fig. 1.3 on page 15 with a total heat consumption for the house of 11.0 kW at a standard outside temperature of -16 °C and a selected room temperature of +20 °C. The diagram shows the heat output curves of two heat pumps at a heating water flow temperature of 35 °C. The intersection points (limit temperature or bivalence point) of the straight line of the heat consumption of the building in relation to the outside temperature and the heat output curves of the heat pumps are approx. -5.0 °C for HP 1 and approx. -9 °C for HP 2. HP 1 would be used for the selected example. A supplementary electric heating system is used to enable year-round heating. This compensates for the difference between the heat consumption of the building in relation to the outside temperature and the heat output of the heat pump for the corresponding air intake temperature.

Design of the supplementary electric heating system:

Total heat consumption on the coldest day

– Heat output of the heat pump on the coldest day

= Output of the heating elements

Example:

11 kW	–	5,5 kW	=	5,5 kW
Heat consumption of the house at –16 °C		*Heat output of the HP at –16 °C*		*Output of the heating elements*

HP 1 should be dimensioned with a heating element that has an electrical output of 6.0 kW for the selected example.

1.3.4.3 Design of brine-to-water and water-to-water heat pumps (monovalent operation mode).

Fig. 1.4 shows the heat output curves of brine-to-water heat pumps. The heat pump with a heat output which is above the intersection of the required total heat consumption and the temperature of the available heat source is to be selected.

Building data:

- Monovalent operating mode (heat pump only)
- Heating system with a maximum flow temperature of 35 °C
- Shut-off time 6 hours (factor f from Tab. 1.3 on p. 13)
- Heat consumption heating **10.6 kW**

Calculation:
required heat output of the heat pump

= heat consumption heating x factor f

= 10.6 kW x 1.3 = **13.8 kW**

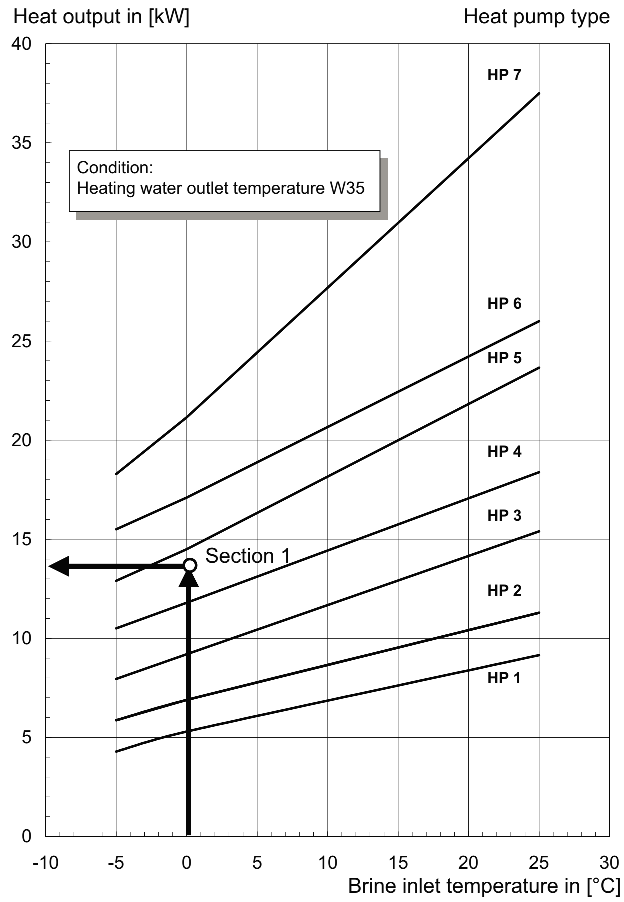


Fig. 1.4: Heat output curves of brine-to-water heat pumps with different heat outputs for flow temperatures of 35 °C.

The output curve of HP 5 must be selected for a maximum required flow temperature of 35 °C for a total heat consumption of 13.8 kW and a minimum brine temperature of 0 °C. This yields a heat output of 14.5 kW for the above boundary conditions.

1.3.4.4 Design of brine-to-water and water-to-water heat pumps (mono energy operation).

Mono energy brine-to-water or water-to-water heat pump systems are equipped with a second electrically operated heat generator, e.g. a buffer tank with an electric heating element. Mono energy brine-to-water or water-to-water heat pump systems should only be planned in exceptional circumstances if shut-off times mean that large quantities of power must be drawn from the grid or if, on account of the available device range, a heat pump must be selected which has a considerably larger output in comparison to the total heat consumption. Mono energy operation is also particularly suitable for the first heating period if the building is dried out in autumn or in the winter.

1.3.4.5 Design of air-to-water heat pumps (bivalent operation)

When a system is operated as a bivalent-parallel system (existing older building), a second heat generator (oil or gas boiler) assists the heat pump from the bivalence point of < 4 °C.

It often makes sense to select a smaller sized heat pump since the heat pump's percentage of annual heat output fluctuates very little. A prerequisite is that **long-term** operation of a bivalent system is planned.

For buildings with radiators as a heat distribution system, heating flow temperatures of 50 °C and more are often permanently required. In this case, it is often advisable to have an additional bivalent alternative operation for heat pumps and boilers, as air-to-water heat pumps in particular offer significantly better outputs in higher outside temperatures. In low outside temperatures, the 2nd heat generator takes over the heating of the building.

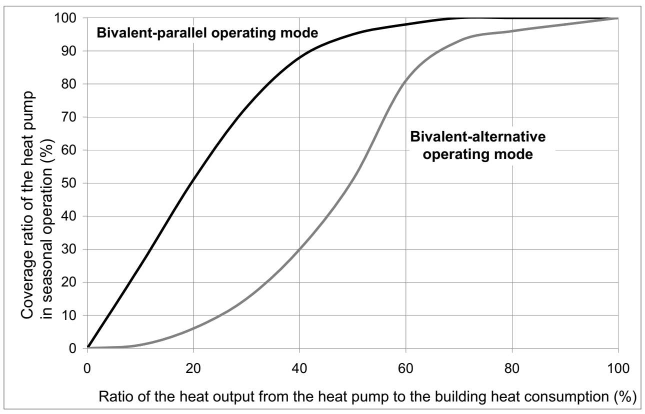


Fig. 1.5: Coverage ratio of a heat pump in different operating modes

The diagram shows the coverage ratio of a heat pump for the operating modes bivalent-parallel and bivalent-alternative depending on the heat consumption of the building using an example building.

NOTE

Experience has shown that, in the case of bivalent systems used in modernisation projects, the existing oil or gas boiler is taken out of service after a few years, for a variety of reasons. Therefore, designing should always be carried out in the same way as the mono energy system (bivalence point is approx. -5 °C). At the same time, the buffer tank should also be integrated into the heat flow.

1.3.4.6 Design of brine-to-water and water-to-water heat pumps (bivalent operation).

The same interrelationships generally apply for bivalent operation of water-to-water and brine-to-water heat pumps as for air-to-water heat pumps. However, other dimensioning factors must be considered depending on the layout of the heat source system.

Ask our heat pump system specialists if you have any questions on this topic.

1.3.4.7 Drying out buildings

When a house is being built, large quantities of water are normally used for mortar, rendering, plaster and wall paper, which only evaporates very slowly from the building. In addition, rain can decisively increase the humidity in the building's structure. This increased humidity in the entire structure causes an increase in the heat consumption of the house during the first two heating periods.

For this reason, buildings should be dried out using specially designed dehumidifiers. If the heat outputs of the heat pump have been marginally calculated and the respective building is to be dried out in autumn or in winter, particularly if brine-to-water heat pumps are implemented, we recommend installing an additional heating element to compensate for increased heat consumption. In the case of brine-to-water heat pumps, this heating element should then only be activated during the first heating period on the basis of the brine flow temperature (approx. 0 °C) or on the basis of the limit temperature (0 °C to 5 °C).

NOTE

In the case of brine-to-water heat pumps, the increased compressor runtimes could cause the heat source to supercool, in turn causing the heat pump to automatically switch off.

2 Air-to-water heat pumps

2.1 Air as heat source

Area of application of air-to-water heat pumps

General information on the operating limits of air-to-water heat pumps is not possible. The operating limits may differ due to different components in the heat pump or different refrigerants. Areas of application include:

- LA ..TAS of -25 °C to +35 °C
- LIA ..IM of -20 °C to +35 °C

NOTE

The operating limits of the different heat pumps can be found in the device information in the attachment.

Availability of outside air as a heat source

- Unlimited

Types of operation

- Mono energy
- Bivalent-parallel (partial-parallel)
- Alternative bivalent mode
- Bivalent-renewable

Buffer tank

The integration of an air-to-water heat pump requires a buffer tank connected in series to ensure that the evaporator (finned heat exchanger) is defrosted by means of reverse circulation. Installation of a buffer tank connected in series also lengthens the runtimes of the heat pump during periods of reduced heating demand (see Chapt. 8.6 on page 103).

Condensate drain

Condensate that forms during operation must be drained off frost-free. To ensure proper drainage, the heat pump must be mounted horizontally. The condensate pipe must have a minimum diameter of 50 mm and must be fed into a sewer in such a way that it is safe from frost. If the condensate is to be fed into sewers where sewer gases may occur, the evaporator must be protected from sewer gases with a siphon. Defrosting takes place up to 16 times per day, with up to 10 litres of condensate being produced each time (see Fig. 2.1 on page 18).

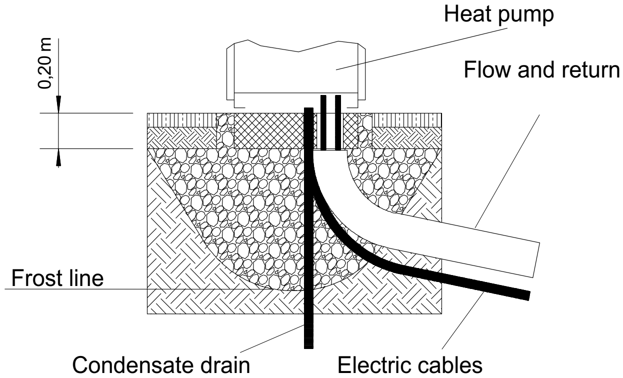


Fig. 2.1: Foundation plan heat pump with condensate drain

NOTE

The frost line can vary according to the climatic region. The regulations of the countries in question must be observed.

ATTENTION!

If the condensation is fed into clearing tanks and sewage systems, a siphon is required in order to protect the evaporator from damaging vapours.

ATTENTION!

The district heating line must be laid so that no water can enter the line via the foundation of the outdoor unit. To this end, the district heating line must be fed approx. 2 - 3 cm out of the foundation.

Recommended Installation

The air-to-water heat pump should preferably be installed outdoors. This is a simple, economical installation option because the requirements placed on the foundations are minimal and this set-up avoids the need for air ducts. Installation is to be done in compliance with the regulations set down in the relevant federal building codes. If outdoor installation is not possible, it should be kept in mind that condensation can form on the heat pump, on air ducts and especially around wall openings when the heat pump is installed in rooms with high humidity.

Frost protection

The heat circulating pump is activated automatically and as required by an integrated frost protection sensor to prevent the heat pump from freezing when it is not in service (Chapt. 8.2 on page 94).

ATTENTION!

The intake air must not contain ammonia. The use of exhaust air from animal stables is therefore not permitted.

Maintenance information

To guarantee safe operation of the heat pump, maintenance work must be carried out on the pump at regular intervals. The following work can be carried out with no special training:

- Cleaning the ribs on the evaporator
- Cleaning inside the heat pump
- Cleaning the condensate tray / condensate drain
- Cleaning the air ducts (air inlet and outlet)

The heat pump must also be checked for leaks and the function of the refrigerant circuit checked at regular intervals.

NOTE

Further information of country-specific standards relating to leakage tightness tests on heat pumps is available at www.dimplex.de/dichtheits-pruefung.

ATTENTION!

Work on components carrying refrigerant may only be carried out by a trained cooling technology specialist.

2.2 Air-to-water heat pumps for outdoor installation

Costs for outdoor installation

- Frost-proof foundation
- Laying insulated heating pipes for flow and return in the ground
- Laying electrical connecting and main cables in the ground.
- Wall openings for connecting pipes
- Condensate drain (frost-proof)
- Follow federal building codes if applicable

Installation

Heat pumps for outdoor installation are equipped with specially coated panels and are therefore weatherproof.

The device should always be installed on a permanently even and horizontal surface. Frost-proof paving slabs or foundations are suitable as a base. The entire frame should lie directly on the ground to ensure a good soundproof seal and to prevent the water-bearing components from becoming too cold. If there are any gaps, these should be sealed with weatherproof insulating material.

ATTENTION!

The heat pump is designed for installation on even ground. If the installation conditions differ (installation on a platform or flat roof) or there is a greater risk of the heat pump tipping over (due to an exposed position or high wind exposure), additional protection against tipping over must be provided.

NOTE

When using Dimplex heat pumps close to the sea, the high salt content in the air may lead to increased corrosion. Heat pumps can be used at distances of 12 km and above from the sea with no problems.

NOTE

In cases of installation close to a wall, there may be more sediment in the air inlet and outlet areas due to the air current. The colder outside air outlet should discharge in such a way as to not increase the heat losses in heated neighbouring rooms.

Minimum clearances

It must be possible to carry out maintenance work without hindrance. This can be ensured by maintaining a clearance of 1.2 m from any solid walls.

Sound insulation measures

The lowest noise emissions are achieved if, from the air outlet side at a surrounding distance of 3-5 metres, there is no sound reflection through reverberative surfaces (i.e. facades).

Additionally, the foundation can be covered up to the height of the covering panels with sound-absorbing material (e.g. bark mulch).

Noise emissions from heat pumps depend on their respective sound power levels and the installation conditions. Please refer to Chapt. 5 on page 56 for more detailed information about the interrelationship between the factors influencing acoustic emissions, sound propagation and acoustic immissions.

Air short circuit

The heat pump must be installed in such a way that the air cooled by the extraction of heat is blown out freely. In cases of installation close to a wall, the air outlet must not face towards the wall.

Installation in a hollow or in an inner courtyard is not permitted because cooled air collects at ground level and is drawn in again by the heat pump during lengthy operation.

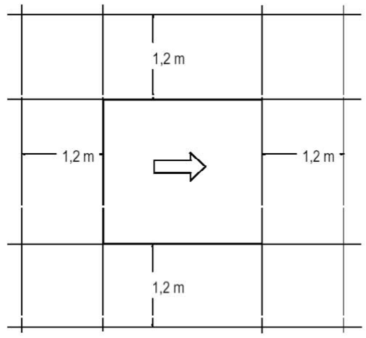


Fig. 2.2: Minimum distances for maintenance work and parallel connection of heat pumps

NOTE

The minimum clearances for maintenance work can be found in the respective installation instructions.

Electrical connection cable

An electrical connecting cable is required when operating air-to-water heat pumps set up outdoors. This enables the heat pump manager installed in the technology room to control all electrical components in the heat pump (e.g. compressor, expansion valve).

Order reference	Heat pumps	Length
EVL 10U - EVL 40U	LA 9TU - LA 40TU LA 35TUR+	10 – 40 m
EVL 10UE - EVL 40UE	LA 6TU LA 60TU	10 – 40 m
EVL 996-1 - EVL 999-1	LA ..AS LA ..PS LA ..MS LA ..TAS/LA ..MAS	10 – 40 m
EVL 10R - EVL 40R	LA ..R	10 – 40 m

Table 2.1: Overview of electrical connecting lines

NOTE

The connecting lines must be ordered as a separate accessory and selected according to the heat pump type.

ATTENTION!

The electric connecting lines are available in the lengths 10, 20, 30 and 40 m. It is not permissible for the customer to extend the control cable.

ATTENTION!

The mains cable must be laid separately from the control cable to guarantee problem-free signal transmission. The electrical connection cables must be laid in a protection tube with a diameter of at least 70 mm.

2.2.1 Parallel connection of air-to-water heat pumps installed outdoors.

When parallel connecting air-to-water heat pumps set up outdoors, a minimum distance must be maintained between the individual heat pumps. This is necessary to prevent an air short circuit between the individual heat pumps. The minimum distances for maintenance work specified in the relevant installation instructions must be taken into account.

A minimum distance of 1.2 m between the individual heat pumps must be complied with (see Fig. 2.3 on page 20).

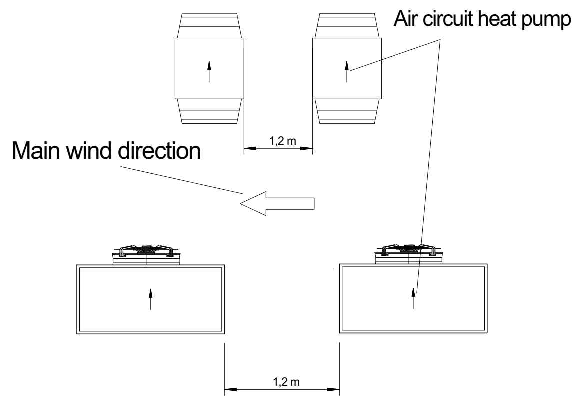


Fig. 2.3: Parallel connection of heat pumps

2.2.2 Connection on the heating side

The domestic heating system is connected using two thermally insulated pipes. Ready-to-use heating water connection cables consisting of two flexible pipes (one for flow and one for return) in one cover pipe with integrated thermal insulation (PE foam), including ready-to-use 90° bend for quick and easy connection to the heat pump are recommended.

The cover pipe is laid underground (frost-free) and is routed through a wall opening into the boiler room.

i NOTE

Adjust the depth of the pipe trenches to the use of the terrain! Ensure loading capacity SWL 60 in areas subjected to stresses caused by vehicles.

The power supply cables (control and main cables) are laid in one or two separate protection tubes (e.g. basic sewer pipe, minimum diameter DN 70).

i NOTE

The distance between the building and the heat pump has an influence on the pressure drop and the heat loss of the connecting pipes and must be taken into consideration when designing the circulating pump and the thickness of the insulation. Pipe lengths of over 30m should be avoided!

The connections of the heat pump are routed out of the device in a downward direction. Refer to the respective foundation plans in the dimension drawings (see "Device information" manual) for the location of the heating pipes and the condensate drain.

i NOTE

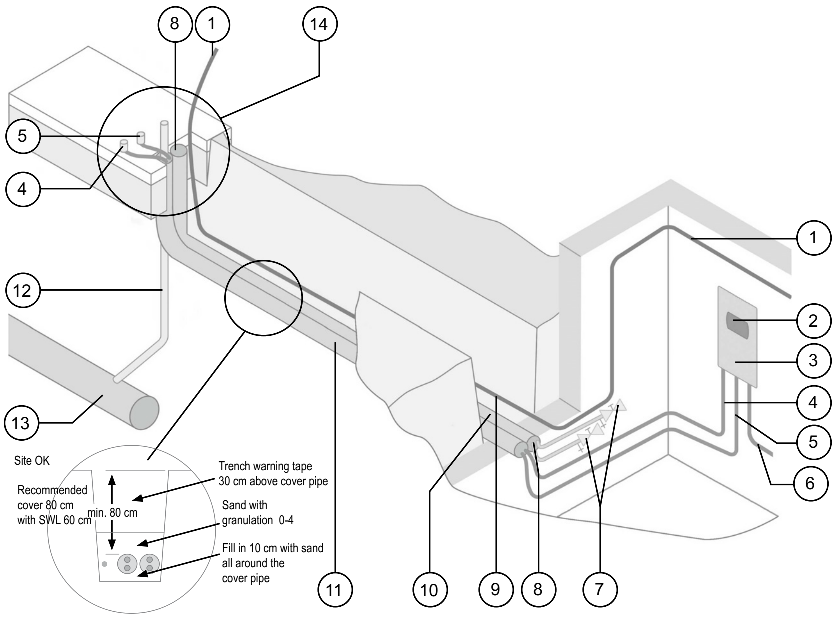
To facilitate installation when using insulated district heating lines, it is recommended to leave these at the base frame of the heat pump and to set up the connection to the heat pump using flexible hoses.

The hoses are fed into the building with insulation and cover pipe. The building can be sealed using a direct feed-through adapted to the heating water connection cable

- in a dry area
- Sealing collar against non-pressuring water (DIN 18337)
- Wall-sealing flange against pressuring water (DIN 18336)

i NOTE

So that water cannot penetrate the house infeeds through brickwork, these must be painted with a bitumen-based protective coating. The house feed-through (flange) must additionally be stabilised with a casing tube to seal it against pressuring water.



Legend:

1) Load current cable of heat pump
2) Control panel of heat pump controller
3) WPM EconPlus heat pump manager
4) Control cable regulation/heat pump 24 V
5) Control cable regulation/heat pump 230 V
6) Electrical supply cable (230 V) for the heat pump manager
7) Isolating and drain device
8) Heating water connection cable
9) Wall openings for electrical connecting cables
10) Wall openings for heating connection cables
11) Basic sewer pipe (at least DN 70) for the electrical connections of the regulation unit/heat pump
12) Condensate drain
13) Rain water outlet/drainage
14) Foundation of the heat pump (please observe the different foundation plans of the heat pumps)

Fig. 2.4: Hydraulic and electrical connections for installation underground

2.2.3 Wall opening

Direct feed-through in dry areas:

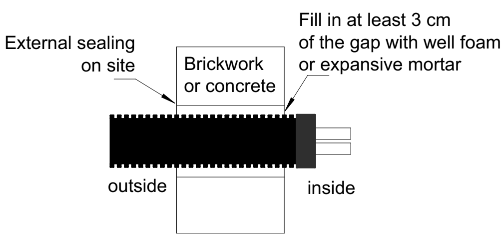


Fig. 2.5: Drawing direct wall feed-through

Indirect feed-through with sealing collar against non-pressuring water

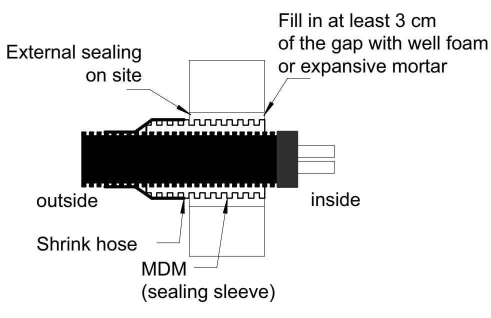


Fig. 2.6: Drawing of wall opening for non-pressuring water

Flange against pressuring water

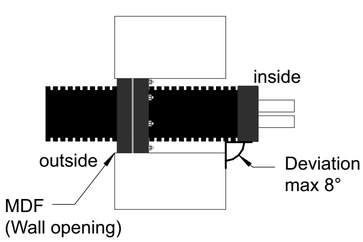


Fig. 2.7: Drawing of wall opening for pressuring water

A filling and drain device must be provided for in the building shortly after the infeed of the heating water connections (approx. 0.8 m below ground level) for the heating water flow and return. For ground-level buildings, a thermally insulated duct is to be provided or drainage must be possible using compressed air.

The recommended bore diameters for the various house feed-throughs can be found in the table below.

House feed-through	Bore diameter
MDM 145	220
MDM 175	260
MDF 145	250
MDF 175	250

Table 2.2: Recommended bore diameter for house feed-throughs

Volume flow/pressure drop diagram, heating water connection cable (HVL)

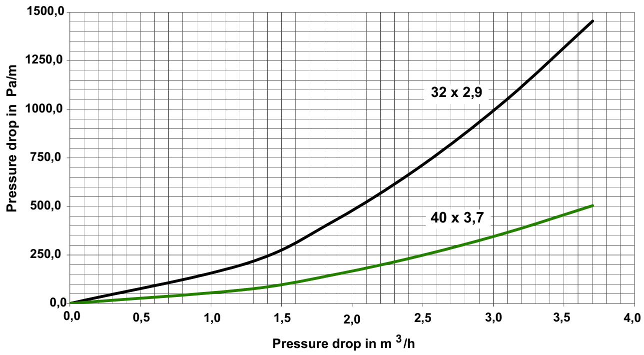


Fig. 2.8: Pressure drop in the heating water connection cable in relation to the volume flow with heat transfer medium heating water (pipe roughness 0.007 mm)

The diagram shows the pressure drop in the heating water connection cable depending on the volume flow per meter. The following table shows the available heating water connection cables.

Type	Length
Heating water connection cable 25-50	5 m + 1.2 m connection pipe
Heating water connection cable 25-75	7.5 m + 1.2 m connection pipe
Heating water connection cable 25-100	10 m + 1.2 m connection pipe
Heating water connection cable 25-150	15 m + 1.2 m connection pipe
Heating water connection cable 32-150	15 m + 1.2 m connection pipe
Heating water connection cable 32-200	20 m + 1.2 m connection pipe
Heating water connection cable 32-250	25 m + 1.2 m connection pipe

Table 2.3: Heating water connection cables

i NOTE

With high-efficiency air-to-water heat pumps, the hydraulic connection can be led out either downwards or to the side (special accessories required). With installation the heat pump close to a wall, above-ground infeed of the heating water connection cables into the building is possible.

2.3 Air-to-water heat pump for indoor installation

Costs for indoor installation

- Air circuit (e.g. ducts)
- Wall openings
- Condensate drain

General

An air-to-water heat pump should not be installed in the living quarters of a building. In extreme circumstances, outside air as cold as -25 °C may pass through the heat pump. This can lead to the formation of condensation in the area around wall openings and air duct connections in rooms with high humidity, e.g. kitchens and laundry rooms, eventually resulting in damage to the building. The formation of condensation cannot be avoided (even with good thermal insulation) if the ambient air humidity exceeds 50 % and the outside temperature is below 0 °C. Unheated rooms such as cellars, storerooms, and garages are therefore more suitable installation locations.

i NOTE

For a higher degree of sound protection, the air outlet should be over a 90° bend, or outdoor installation should (Chapt. 2.2 on page 19) be selected.

If the heat pump is installed on an upper floor, the load-bearing capacity of the ceiling should be checked. Installation on floors above wooden ceilings is not recommended.

i NOTE

If the heat pump is installed above inhabited rooms, constructional measures for solid-borne noise insulation are required.

Air circuit

Air-to-water heat pumps installed indoors must be supplied with a sufficient air volume flow to ensure efficient and smooth operation. This is based primarily on the respective heat output of the heat pump and is between 2,500 and 9,000 m³/h (see "Device information" manual). The minimum dimensions for the air duct must be observed.

Air circulation from the air intake through the heat pump to the air outlet should be as unhindered as possible, so that any unnecessary air resistance is avoided (Chapt. 2.3.7 on page 25).

2.3.1 Requirements placed on the installation location

Ventilation

The room in which the heat pump is installed should preferably be ventilated with outside air so that the relative humidity level remains low and the formation of condensate is avoided. Condensate can form on cold components in particular during system commissioning and when the building is being dried out.

⚠ ATTENTION!

The heat pump must not be operated without appropriate air circulation because of the risk of injury caused by rotating parts (fan).

Air permeability in buildings

The air permeability must not exceed certain limit values depending on the building type and technical equipment. These limit values are defined in DIN 4108-7 "Heat Insulation and Energy Saving in Buildings - Part 7 Air Tightness in Buildings". The procedure for measuring a building and how the heat pump measurement is to be taken into account is defined in DIN EN 13829 "Determination of Air Permeability of Buildings".

2.3.2 Air intake or air outlet via light wells

If the wall openings for the intake or outlet air ducts are below ground level, we recommend routing of the air circuit through streamlining plastic light wells. An air deflector must be installed if the wells are made of concrete. The light well on the air outlet side should be equipped with sound-absorbing cladding. Weather-resistant mineral fibre sheets with a volume weight of approx 70 kg/m³ or open-cell foam, e.g. melamine foam, are suitable for this purpose.

- Minimum dimensions for the wells: 1,000 x 400 to 1,000 x 650 mm
- The transition between the light well and the wall opening (see Chapt. 2.3.4 on page 23) should be sealed
- Cover with grating (guard against burglary)
- An outlet for condensate must be provided
- A wire grating (> 0.8 cm mesh size) should be fitted to prevent small animals from entering and leaves from falling in.

NOTE

Refer to the device information for the minimum dimensions for the air ducting.

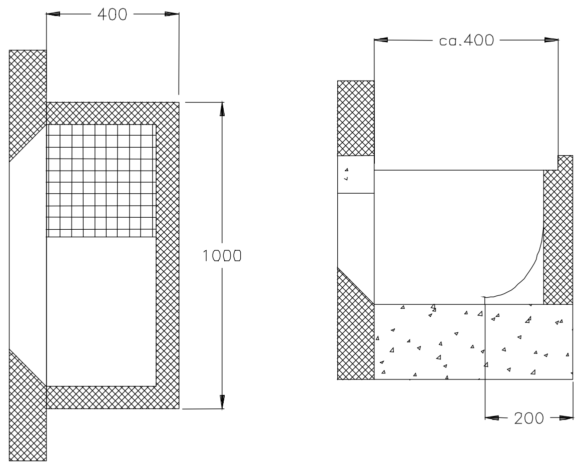


Fig. 2.9: Minimum light well dimensions

2.3.3 Heat pump rain guard

Rain guards act as a visual covering for wall openings above ground and also protect the air ducts from the effects of the weather. It is fixed to the wall from the outside and can be used with any type of air circuit. The rain guard (special accessory) has been specially developed for heat pumps and features a significantly lower pressure drop than standard rain guards. It can be used either on the air intake or the air outlet side.

A wire grating should be fitted between the wall and the rain guard to prevent small animals from entering and leaves from falling in. At least 80% of the grating’s cross section must be open (mesh size > 0.8 cm). Measures to safeguard the rain guard against burglary are to take place on site.

Item	Designation	500-700	800	900	1,500
1	Rain guard	1 items	1 items	1 items	1 items
2	Dowel 6 x 30	4 items	6 items	8 items	14 items
3	Screw 5 x 70	4 items	6 items	8 items	14 items

Table 2.4: Fixing material for rain guard

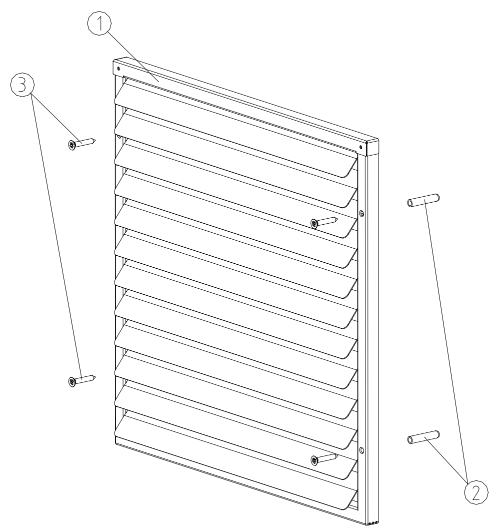


Fig. 2.10: Heat pump rain guard

2.3.4 Insulation of wall openings

Necessary wall openings should be provided on site. It is essential that the interior side of the wall opening is lined with thermal insulation to prevent the wall from becoming cold and to prevent moisture from penetrating the wall. For example, Fig. 2.11 on page 23 illustrates insulation using rigid polyurethane foam (25 mm insulation thickness). The transition between the wall insulation and the wall-mounted junction box must be sealed airtight. Water which has penetrated due to adverse weather conditions (e.g. driving rain) should be routed outside by means of a downward slope.

NOTE

To prevent moisture from penetrating the wall and the resulting formation of mould, the air circuit must be thermally insulated all the way to the outer edge of the building envelope.

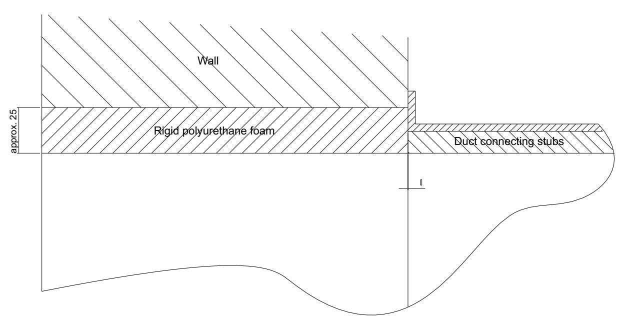


Fig. 2.11: Example of how to construct the wall opening

2.3.5 Air duct hose kit for air-to-water heat pumps

Flexible hoses are offered as accessories for the air circuit for the air-to-water heat pumps LI 11TES and LI 16TES. The air duct hose kit is suitable for use in rooms with low temperatures and low humidity. It contains a 5 m length of thermally-insulated and sound-insulated air hose which can be used for both the air intake and the air outlet side. Air intake and air outlet can take place via a light well or a rain guard. Installation material for connection to the heat pump and for the wall opening to be insulated on site is included.

Air hoses have the advantage that they can be individually adapted on site and are able to simply and quickly compensate for height and length differences. In addition, air hoses have both a thermal and sound insulating effect and prevent the room in which the system is installed from becoming cold. A grid on the wall connection stubs prevents small animals from entering and leaves from falling in.

NOTE

The minimum air flow should be checked if there is an air deflection of more than 90° on the air intake and air outlet side.

Dimensions in mm	DN 500	DN 630
A	560	652
B	585	670
C	495	625
D	100	100

Table 2.5: Dimensions of the air duct hose kit

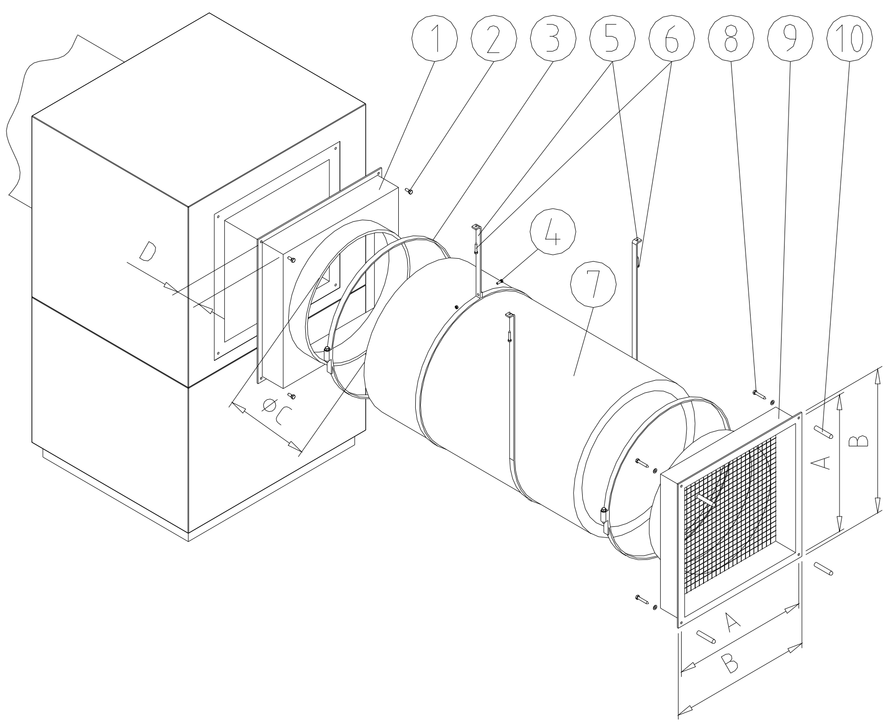


Fig. 2.12: Air duct hose kit

Scope of supply

1) Connecting stubs on the heat pump
2) Hexagon bolt
3) Connection clamp
4) Hexagon bolt
5) Perforated tape
6) Dowel
7) Connection hose insulation thickness 25 mm
8) Screw
9) Connecting stubs (wall-mounted)
10) Dowel

Minimum bend radius LUS 11: 300 mm

Minimum bend radius LUS 16: 400 mm

Space requirement for 90° bend: approx. 1 m

2.3.6 Lightweight cement based fibre glass air ducts for air-to-water heat pumps (indoor installation)

The diffusion-open and moisture-resistant air ducts are available pre-assembled or as a construction kit. They are supplied in each respective cross section as 90° bends and as 1,000 mm (construction kit) and 625 mm or 1250 mm (pre-assembled) extensions.

The mineral wool and laminated glass fiber pad insulation on the inside helps prevent the formation of condensate and significantly reduces sound transmission by ~ 1 dB(A) per running meter or ~ 2 to 3 dB(A) per bend. The ends are fitted with zinc-plated pressed steel frames.

The ducts can be painted with standard emulsion paint as desired.

Minor damage to the outer surface has no affect on the efficiency and can be repaired with standard plaster.

Assembly of a standard installation set-up:

Air ducts can be mounted unshortened if a standard installation set-up (see Chapt. 2.3.7.1 on page 26) is selected.

The required minimum clearances between the heat pump and walls should always be observed when positioning the air circuit.

The air ducts or bends are sealed in the wall opening with standard polyurethane foam in accordance with the dimensions in the drawing. The ducts are supported at regular intervals from below or using threaded rods from the ceiling.

NOTE

For solid-borne noise insulation, the air ducts are not screwed directly onto the heat pump.

A clearance of approx. 2 cm should be left between the heat pump and the duct to simplify future disassembly of the heat pump. The seal to the heat pump takes place with a sealing collar available as an accessory (see Fig. 2.13 on page 25).

Butt joint between two duct sections:

The duct sections are equipped with a metal frame to facilitate connection.

The components are sealed off from one another by gluing standard foam rubber or by applying silicone compound between the metal frames.

Cutting lengths:

Pre-assembled air ducts can be shortened or adapted on site using the conversion kit available as an accessory. This processing set does not apply for air duct construction sets. They can be shortened or adapted before the actual bonding. The resulting cut edges are coated with a suitable adhesive paste (i.e. silicone) and the ends are then fitted with zinc-plated channel sections.

Sealing collar

The sealing collar is used to seal the glass fibre reinforced lightweight concrete air ducts on the heat pump. The air ducts themselves are not screwed directly onto the heat pump. When the system is installed ready for operation, only the rubber seal comes into direct contact with the heat pump. This guarantees easy assembly and disassembly of the heat pump and also ensures that solid-borne noise is well insulated.

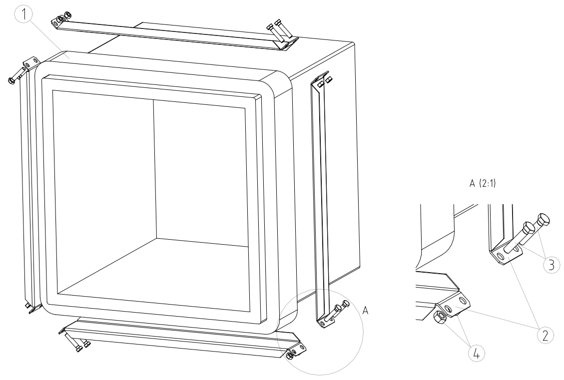


Fig. 2.13: Sealing collar for air ducts

2.3.7 Dimensioning the air circuit with lighweight cement based fibre glass air ducts

It should be borne in mind when dimensioning the air circuit (air intake and air outlet) that the maximum pressure drop (max. compression) of the individual components must not exceed the free compression value listed in the device information (see "Device information manual"). Both cross sectional areas which are too small and deflections (e.g. rain guards) which are too extreme can cause impermissibly high pressure drops and lead to ineffective or faulty operation.

Air circuit components	Pressure drop
Air duct straight	1 Pa/m
Air duct bend	7 Pa
Rain guard	5 Pa
Light well air intake	5 Pa
Light well air outlet	7-10 Pa

Table 2.6: Reference values for the air circuit system accessories

NOTE

The air circuit within the building should have a maximum of two 90° deflections to ensure compliance with the maximum permissible pressure drops.

The air circuit components available as special accessories are designed in such a way that their values are below the permissible compressions for the standard installation set-ups shown (see Chapt. 2.3.7.1 on page 26). This means that it is not necessary to check the overall pressure drop. A light well or a wall opening with a rain guard can be used for the air intake and air outlet.

ATTENTION!

The minimum air flow should be checked whenever the set-up deviates from the standard connections or third-party air circuit components are fitted.

Selection of air circuit components

The following air circuit components are available in four different sizes to correspond to the available performance levels:

- Rain guard
- Air duct (duct/bend)
- Sealing collars

Unit type	Air circuit components	Comment
LIK 8ME / LIK 8TES / LI 9TES	Type 500	
LI 11ME / LI 11TES	Type 600	
LIKI 14TE / LI 15TE	Type 600	Air outlet
LI 9TU / LI 12TU	Type 600	Air outlet
LI 16TES / LI 20TE	Type 700	
LI 24TE / LI 28TE / LIH 26TE	Type 800	
LIKI 14TE / LI 15TE	Type 800	Air intake
LI 9TU / LI 12TU	Type 800	Air intake
LI 40AS	Type 900	

Table 2.7: Allocation of air circuit components

Fig. 2.14: Components for construction kit LKL ..A

The air duct construction kit LKL ..A (see Fig. 2.14 on page 25) is made up of side walls made from glass fiber reinforced concrete incl. adhesive and two cover frames. It is not delivered pre-assembled and must be assembled on-site. This means that the air duct can be transported easily and shortened to the desired length on-site.

Benefits construction kit LKL ..A

- Low risk of damage during transport
- Construction kit can be shortened to the desired length easily on-site
- Cover frame enables quick and easy assembly

2.3.7.1 Dimensions of the wall openings when using lightweight cement based fibre glass air ducts

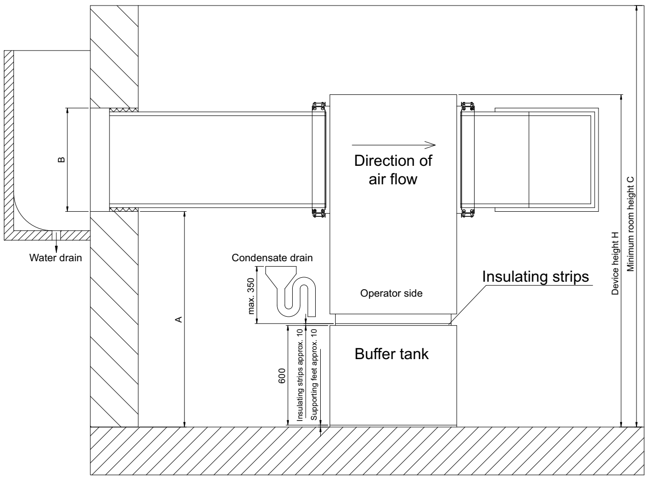


Fig. 2.15: Front view 600-800

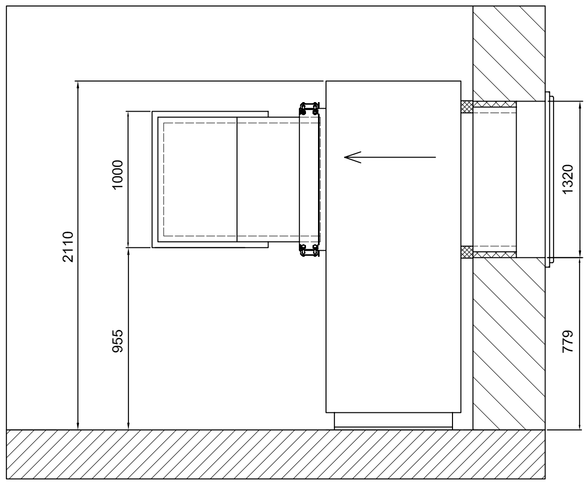


Fig. 2.17: Front view 900

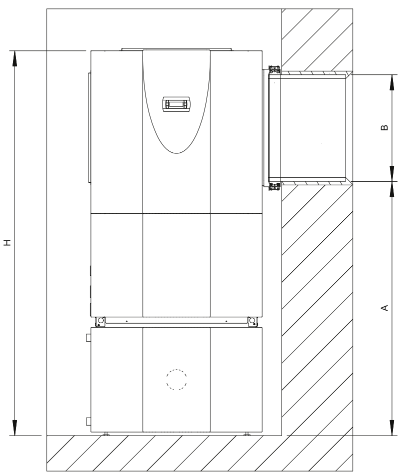


Fig. 2.16: Front view LI 9TU, LI 12TU and LI 15TE

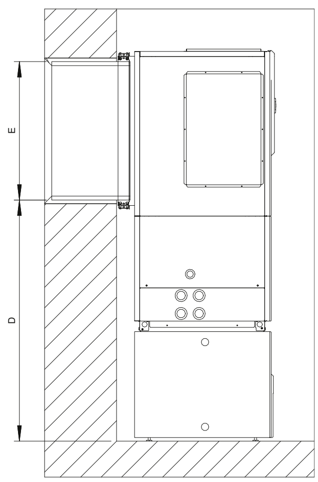


Fig. 2.18: Side view LI 9TU, LI 12TU and LI 15TE

Type	Heat pump	A (in mm) with buffer	A (in mm) without buffer	B (in mm)	D (in mm) with buffer	D (in mm) without buffer	E (in mm)	C (in mm)	H (in mm) with buffer	H (in mm) without buffer
600	LI 11ME / LI 11TES	1,282	672	650	-	-	-	2,200	1,981	1,371
700	LI 16TES / LI 20TE	1,340	730	745	-	-	-	2,400	2,191	1,581
600/800	LI 9TU / LI 12TU / LI 15TE	1,430	822	600	1,339	730	769	2,400	2,164	1,556

Table 2.8: Table of dimensions heat pump with buffer tank

Built-under buffer tank

Built-under buffer tanks on which heat pumps can be installed are available for various heat pumps with indoor installation. This increases the overall installation height of the heat pump, so that the air ducts can be installed directly below the ceiling.

Unit type	Buffer tank
LI 9TU / LI 12TU	PSP 120E
LI 15TE	PSP 120E
LI 11TES / LI 16TES / LI 20TE	PSP 140E

Table 2.9: Built-under buffer tank for air-to-water heat pumps installed indoors

The dimensions for the installation of the heat pump and the position of the wall openings are determined as follows:

1. Step: Determine the type of air circuit components required depending on the type of air-to-water heat pump to be installed according to *Table 2.7 on page 25.*

2. Step: Select the required installation version.

3. Step: Extract the required values pertaining to the respective installation version from the table of dimensions.

2.3.7.2 Installation in a corner

Installation examples

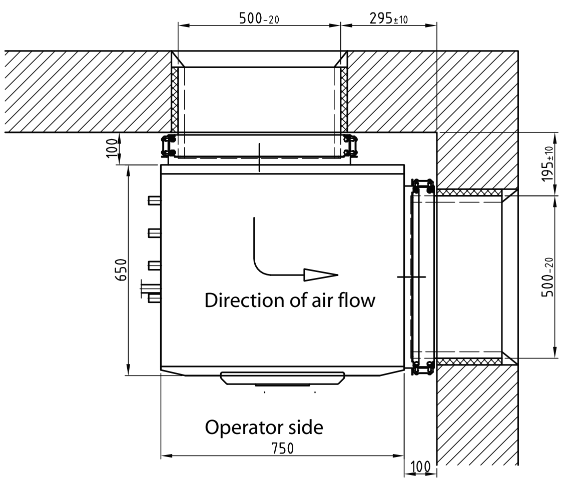


Fig. 2.19: Installation in a corner 500 (LIK 8TES with air duct)

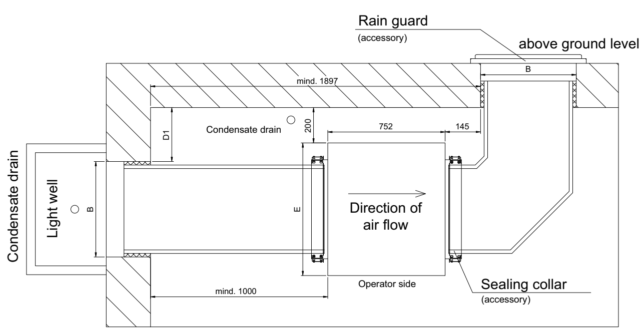


Fig. 2.20: Installation in a corner

Type	Heat pump	B (in mm)	D1 (in mm)	E (in mm)
600	LI 11TES	650	301	852
700	LI 16TES / LI 20TE	745	254	852
800	LI 24TE - LI 28TE / LIH 26TE	820	291	1,002

Table 2.10: Table of dimensions for installation in a corner (see Fig. 2.20 on page 27)

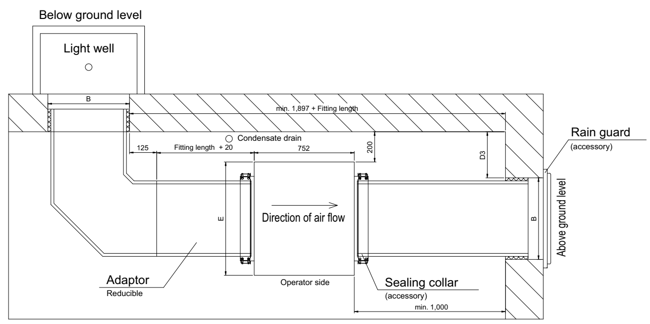


Fig. 2.21: Installation in a corner with adapter

Type	Heat pump	B (in mm)	D3 (in mm)	E (in mm)
600	LI 11TES	650	301	852
700	LI 16TES / LI 20TE	745	254	852
800	LI 24TE - LI 28TE / LIH 26TE	820	291	1,002

Table 2.11: Table of dimensions for installation in a corner with adaptor (see Fig. 2.21 on page 27)

⚠ ATTENTION!

If air duct dimensions are included in the drawing, the size of the wall openings must be increased accordingly.

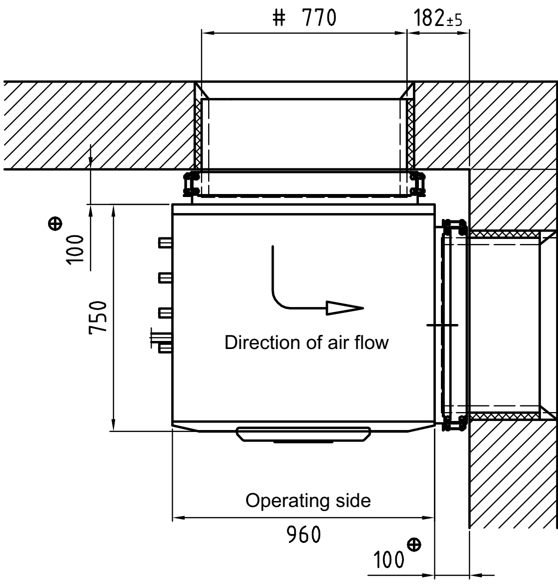


Fig. 2.22: Installation in a corner LIKI 14TE (with air duct)

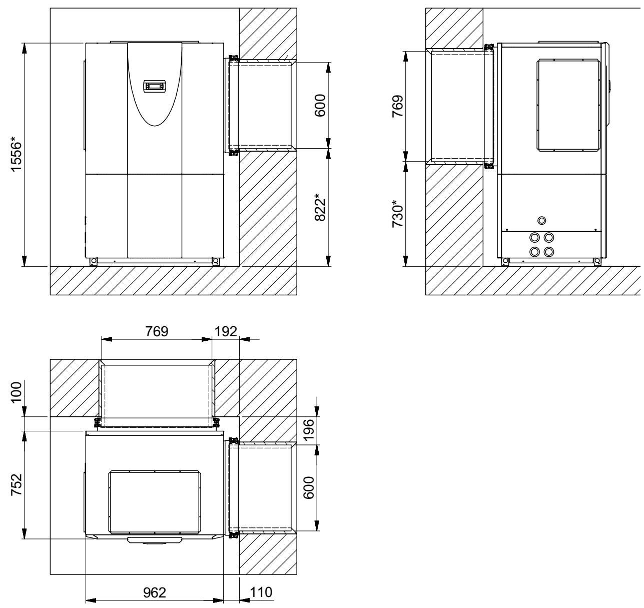


Fig. 2.23: Installation in a corner LI 9, 12TU and LI 15TE (with air duct)

ATTENTION!

If air duct dimensions are included in the drawing, the size of the wall openings must be increased accordingly.

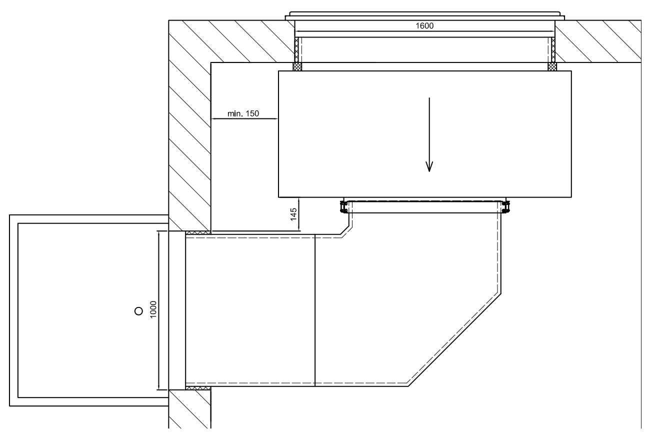


Fig. 2.24: Installation in a corner on the left LI 40AS

2.3.7.3 Wall installation

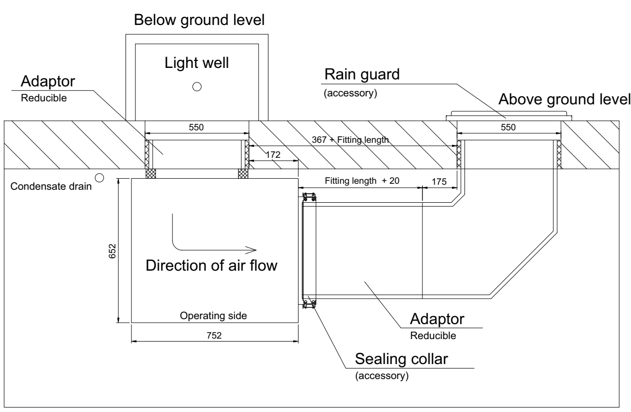


Fig. 2.25: Wall installation 500

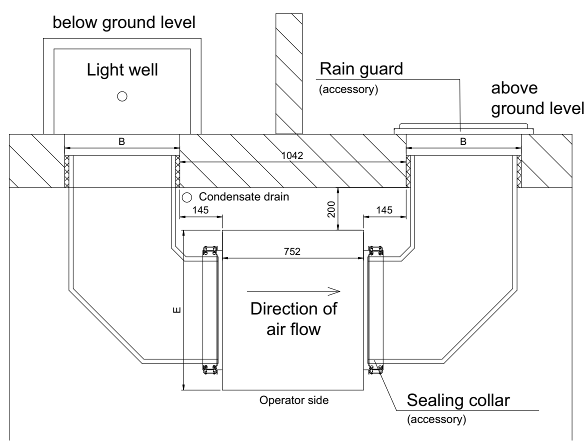


Fig. 2.26: Wall installation

Type	Heat pump	B (in mm)	E (in mm)
600	LI 11ME / LI 11TES	650	852
700	LI 16TES / LI 20TE	745	852
800	LI 24TE - LI 28TE / LIH 22TE - LIH 26TE	820	1,002

Table 2.12: Table of dimensions for wall installation

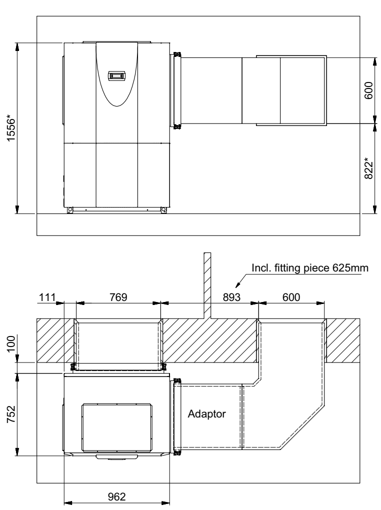


Fig. 2.27: Wall installation LI 9, 12TU and LI 15TE (dimensions of the heat pumps are identical)

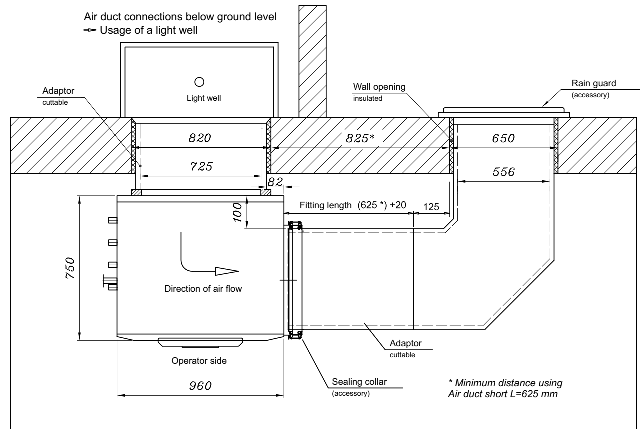


Fig. 2.28: Wall installation LIKI 14TE

NOTE

Either a light well or a rain guard should be used for the air outlet to avoid shorting the air circuit.

ATTENTION!

If air duct dimensions are included in the drawing, the size of the wall openings must be increased accordingly.

2.4 Air-to-water heat pump in split design

Split heat pumps consist of an outdoor and indoor unit connected by refrigerant pipes. The outdoor unit contains the compressor, an evaporator supplied with air and the expansion valve, the indoor unit contains the liquefier. They are used to transfer the energy contained in the refrigerant to the heating circuit for heating and domestic hot water preparation.

Application areas of the split heat pump

-20 °C ... + 35 °C

Availability of outside air as a heat source:

- Unlimited

2.4.1 Installation

When installing split heat pumps, various different requirements must be taken into account with regard to set-up and minimum space requirements. The refrigerant pipes and electric cables between the indoor and outdoor unit must be fed through the building wall. The wall openings described under Chapt. 2.2.3 on page 21 can be used for sealing. They are available as accessories.

Development costs outdoor unit

- Laying electrical connection and mains cables
- Laying refrigerant pipes between indoor and outdoor unit
- Wall openings for connecting pipes
- Minimum clearances must be observed (see Fig. 2.29 on page 29)
- Follow federal building codes if applicable

Types of operation:

- Mono energy
- bivalent (external control of the 2nd heat generator)

Advantages of split heat pumps

- Lower development costs for connection to the heat source outside air
- Minimal space requirement, flexible and simple installation
- Low air noise in and on the building through slow running axial fan

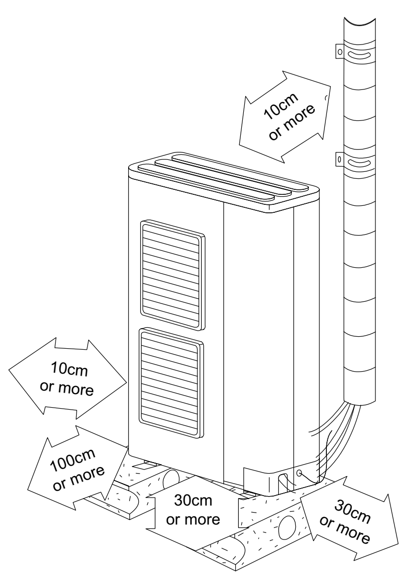


Fig. 2.29: Outdoor unit installation

Condensate drain of the outdoor unit

Condensate occurring in the outdoor unit during operation must be drained off frost-free. To this end, a drain elbow must be mounted on the base of the outdoor unit (see Fig. 2.30 on page 30). In warmer regions, the installation of a condensate tray heater in addition to this is also recommended. In colder regions that experience long periods of frost, the installation of condensate tray heating is absolutely essential. The condensate tray heating is available as an accessory.

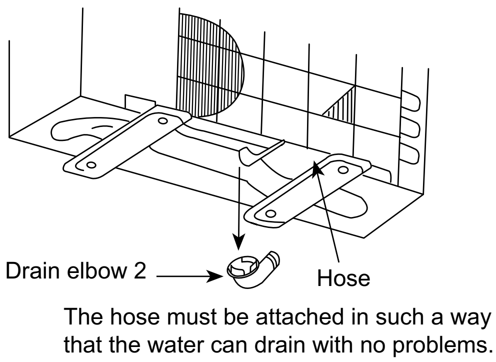


Fig. 2.30: Condensate drain outdoor unit

Development costs indoor unit

- Do not install any heat source in the vicinity of the device.
- Ensure that there is a good circulation of air inside the room
- The device must be installed on the wall vertically
- The device must be mounted in a room which is free of frost
- Minimum clearances must be observed (see Fig. 2.31 on page 30)

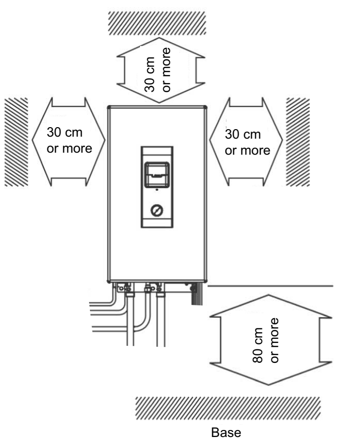


Fig. 2.31: Indoor unit installation

2.4.2 Dimensioning

The heat output of air-to-water heat pumps decreases when the outside temperature drops, while the heat consumption of the building increases at the same time. The heat pump must be selected in such a manner so that the controlling range between the minimum and maximum heat output covers the majority of the annual heat output. If the building's heat consumption exceeds the maximum heat output of the split heat pump, the supplementary electric heater is activated.
The split heat pumps LIA 7IM and LIA 9IM are also equipped with a 3 kW pipe heater. With the models LIA 12 to LIA 16IM, a 6 kW pipe heater is already pre-installed. The diagrams show two design examples for a standard outside temperature of -5 °C and -15 °C respectively.

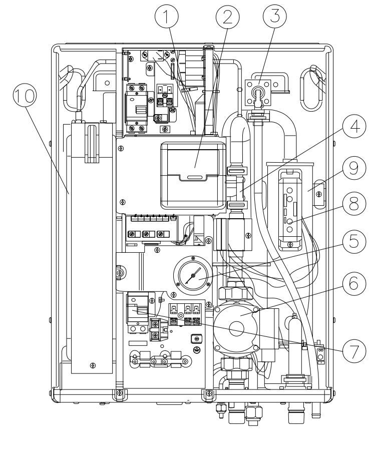


Fig. 2.32: LIA 7IM / LIA 9IM basic device

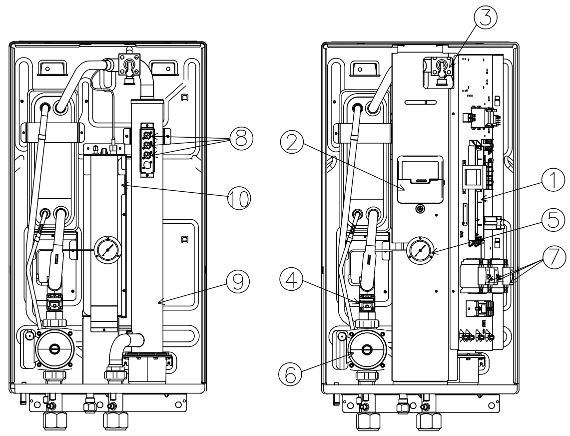


Fig. 2.33: LIA 12IM / LIA 14IM / LIA 16IM basic device

1) Indoor unit main circuit board
2) Control panel
3) Pressure relief valve
4) Flow switch
5) Pressure gauge
6) Circulating pump
7) RCCB (3 units)
8) Overload protection (3 units)
9) Pipe heater
10) Expansion vessel

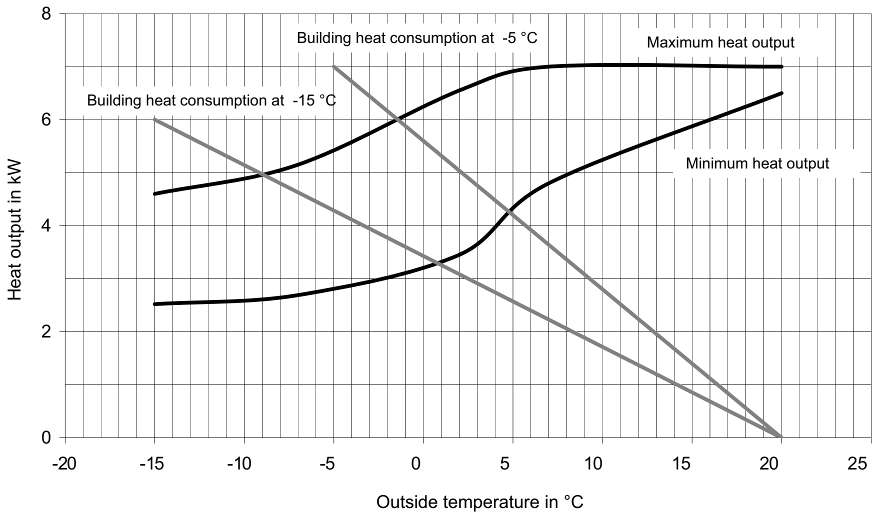


Fig. 2.34: Design example LIA 7IM

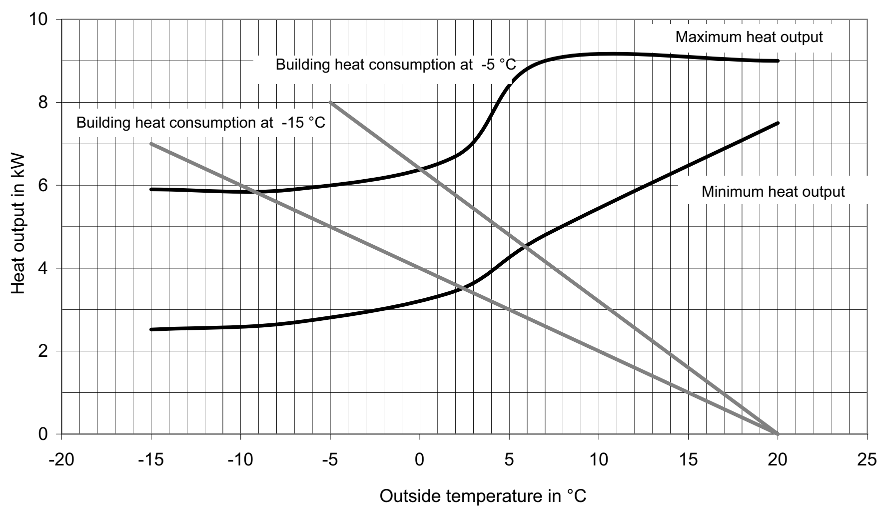


Fig. 2.35: Design example LIA 9IM

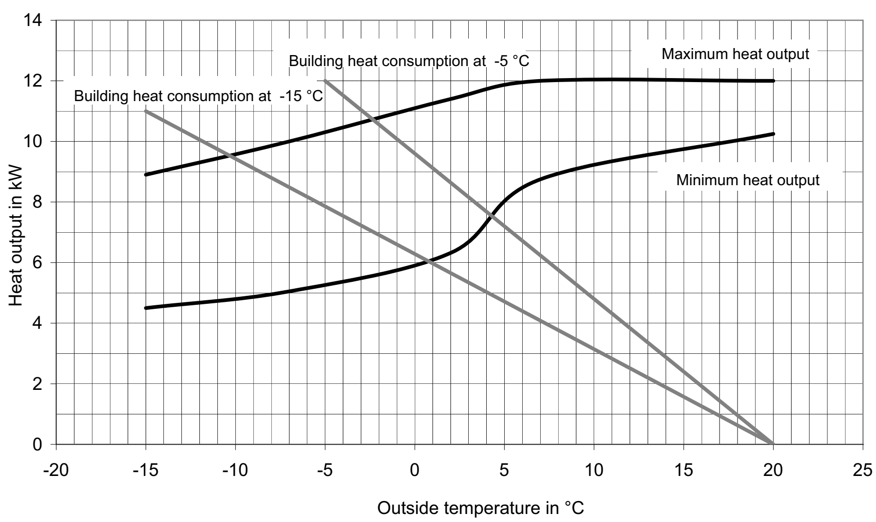


Fig. 2.36: Design example LIA 12IM

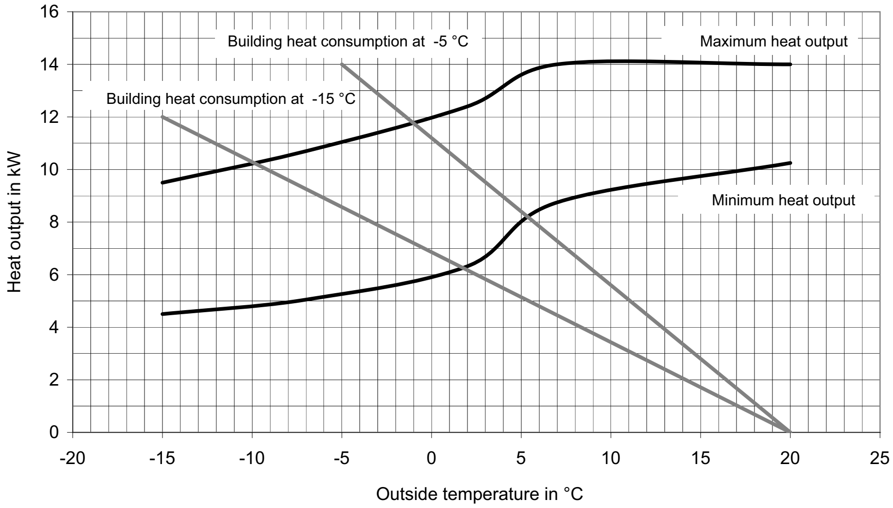


Fig. 2.37: Design example LIA 14IM

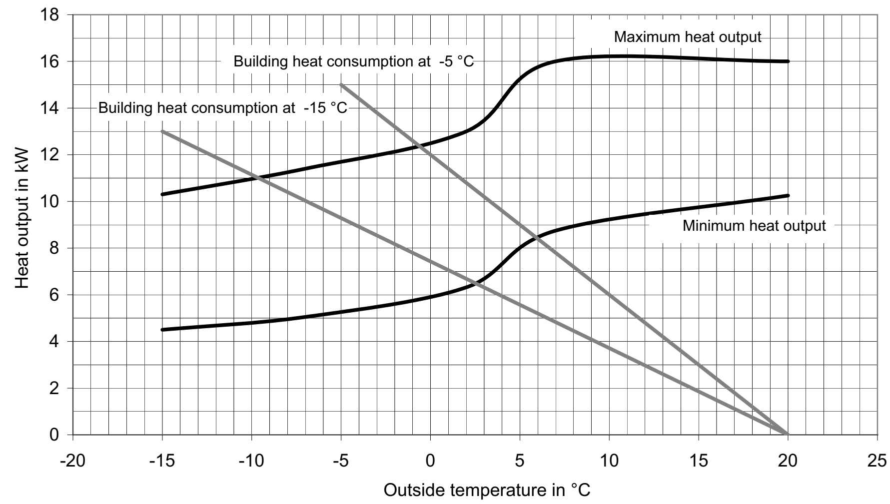


Fig. 2.38: Design example LIA 16IM

The connection between the indoor and outdoor unit takes place via refrigerant pipes. Unfilled refrigerant pipes with a length of 25 m are available as accessories. If the distance between the indoor and outdoor unit is larger than 10 m with split heat pumps LIA 7IM or LIA 9IM, additional refrigerant must be added. This means that, with an LIA 7IM with a distance of 20 m between the indoor and outdoor unit, 300 g refrigerant must be added (see Table 2.13 on page 32).

⚠ ATTENTION!

Assembly and maintenance work on refrigerant lines may only be carried out by trained specialists

⚠ ATTENTION!

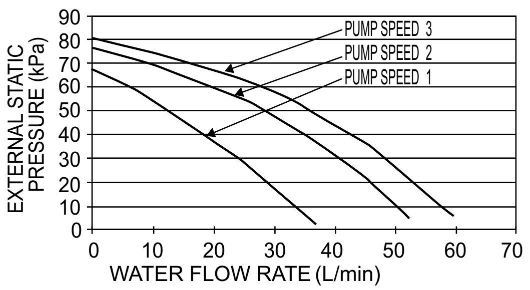
If the indoor unit is mounted 4 or more metres higher than the outdoor unit, a refrigeration specialist must perform a separate check to ensure that the devices for conveying the oil up and down the pipes have been installed correctly in the hot gas pipe.

Model	Pipe length		Nominal length (m)	Max. height diff. (m) outdoor unit	Min. line length (m)	Max. line length (m)	Additional refrigerant (g/m)
	Gas	Liquid					
LIA 7IM	5/8“	1/4“	7	20	3	30	30
LIA 9IM	5/8“	1/4“	7	20	3	30	30
LIA 12IM	5/8“	3/8“	7	30	3	30	-
LIA 14IM	5/8“	3/8“	7	30	3	30	-
LIA 16IM	5/8“	3/8“	7	30	3	30	-

Table 2.13: Design table for refrigerant refilling

2.4.3 Hydraulic integration

Split heat pumps can be used either in mono energy mode or as a bivalent system for heating a building. In contrast to air-to-water pumps for outdoor installation, the buffer tank for split heat pumps can also be integrated in the heating return, as these pumps already have pre-installed pipe heating for defrosting in the indoor unit. A minimum flow rate of 30 l/min is required to operate the heat pump safely. The flow can be controlled via the heat circulating pump integrated in the indoor unit. The flow rate for the circulating pump can be found in the following diagram.



- The characteristic flow rate for the indoor unit is as stated above.

Fig. 2.39: Flow rate

Mono energy mode of operation

The split heat pump can be used for heating and domestic hot water preparation. The heat pump is regulated according to the outside temperature via an outside temperature sensor. If the output of the heat pump is no longer sufficient, the controller activates the pipe heater integrated in the indoor unit. The switch between domestic hot water preparation and heating takes place via a three-way reversing valve. A sample hydraulics for mono energy split heat pump operation can be found in Chapt. 8.15.11 on page 129.

Bivalent operating mode

For split heat pumps combined with an existing boiler, the boiler is still controlled by the existing boiler controller. The maximum flow temperature of the split heat pump is also restricted to 60 °C via an additional thermostat.

In bivalent-alternative operation, the heat pump is switched off by the additional thermostat if a specific temperature is exceeded. The bivalence point of the heat pump must be set to -15 °C to prevent the installed pipe heater from switching on. The heating curve of the heat pump must also be set so that there is a higher set temperature above the bivalence point than with the boiler controller. A sample hydraulics for bivalent split heat pump operation can be found in Chapt. 8.15 on page 113.

i NOTE

Domestic hot water preparation via the heat pump is not possible with this integration.

3 Brine-to-water heat pump

3.1 Ground as a heat source

Temperature range of the ground surface at approx. 1 m depth	+3...+17 °C
Temperature range in deep layers (approx. 15 m)	+8...+12 °C
Operating range of the brine-to-water heat pump	-5 to +25 °C

NOTE

If commissioning is carried out by the after-sales service and the antifreeze contains 30% monoethylene glycol, the lower operating limit of the high-efficiency brine-to-water heat pumps can be expanded to -10 °C.

Types of operation

- Monovalent
- Mono energy
- Bivalent (alternative, parallel)
- Bivalent-renewable

NOTE

Notes on the indirect use of the ground water as a heat source and/or of waste heat from cooling water with the combination of brine-to-water heat pumps and intermediate heat exchangers can be found in Chapt. 3.5 on page 45.

3.1.1 Dimensioning information - ground heat source

The ground heat exchanger, which serves as a heat source for the brine-to-water heat pump, should be designed according to the refrigerating capacity of the heat pump. This can be calculated using the heat output minus the electric power consumption of the heat pump as calculated in the design point.

NOTE

A heat pump with a higher COP has, at comparable heat output, less electrical power consumption and, therefore, higher refrigerating capacity.

When replacing an older heat pump with a newer model, check the capacity of the ground heat exchanger and, if necessary, modify it to suit the new refrigeration capacity.

Under ground, heat is conveyed almost solely by thermal conduction, whereby the thermal conductivity increases with increasing water content. Like the thermal conductivity, the heat storage capacity is also largely determined by the water content of the ground. If the water in the ground is frozen, the amount of energy which can be extracted increases considerably because the latent heat of water at approx. 0.09 kWh/kg is very high. Therefore, optimal utilisation of the ground as a heat source is not impaired if the buried pipe coils freeze.

Dimensioning of the brine circulating pump

The brine volume flow rate depends on the output of the heat pump, and is conveyed by the brine circulating pump. The brine flow rate specified in the "Device information" manual results in a heat source temperature spread of approx. 3K.

In addition to the volume flow rate, the pressure drops in the brine circulation system and the technical data of the pump manufacturer should also be taken into consideration. The pressure drops in pipes connected in series, installed components and the heat exchangers should be added.

NOTE

The pressure drop of an antifreeze/water mixture (25 %) is 1.5 to 1.7 times higher (see Fig. 3.2 on page 36) than that of pure water, whereas the capacity of many circulating pumps drops by approx. 10 %.

NOTE

A detailed outline of ground heat collectors is possible for all regions in Germany with the operating cost calculator at www.dimplex.de/betriebskostenrechner.

Maintenance information

To guarantee safe operation of the heat pump, maintenance work must be carried out on the pump at regular intervals. The following work can be carried out with no special training:

- Cleaning inside the heat pump

NOTE

Further information of country-specific standards relating to leakage tightness tests on heat pumps is available at www.dimplex.de/dichtheitspruefung.

NOTE

Further information on heat pump maintenance is available in the heat pump installation instructions.

ATTENTION!

Work on components carrying refrigerant may only be carried out by personnel with relevant training.

3.1.2 Drying out buildings

When a house is being built, large quantities of water are normally used for mortar, rendering, plaster and wall paper, which only evaporates very slowly from the building. In addition, rain can further increase the humidity in the building's structure. This increased humidity in the entire structure causes an increase in the heat consumption of the house during the first two heating periods.

For this reason, buildings should be dried out using specially designed dehumidifiers. If the heat outputs of the heat pump have been marginally calculated and the respective building is to be dried out in autumn or in winter, particularly if brine-to-water heat pumps are implemented, we recommend installing an additional heating element to compensate for increased heat consumption. This should then only be activated during the first heating period, depending upon the brine flow temperature (approx. 0°C).

i NOTE

In the case of brine-to-water heat pumps, the increased compressor runtimes could cause the heat source to supercool, in turn causing the heat pump to automatically switch off.

3.1.3 Brine fluid

Brine concentration

Antifreeze should be added to the water on the heat source side to prevent frost damage to the evaporator of the heat pump. Frost protection is required down to -14°C to -18°C for pipe coils buried underground, due to the temperatures that may occur in the refrigerating cycle. A monoethylene glycol-based antifreeze is used. The brine concentration for installation underground ranges from 25% to a maximum of 30%.

A mixture of water and antifreeze is used as a heat transfer medium to achieve a lower freezing point. Ethanediol (ethylene glycol) is used as antifreeze in the majority of systems in Germany, Austria and Switzerland. Due to the material used in the brine accessories, the more environmentally-friendly ethylene- and propylene glycol can be used in Dimplex heat pumps without corrosion inhibitors.

Name	Synonym	Chemical formula
Eethanediol	Ethylene glycol	C2H6O2
1,2 propanediol	Propylene glycol	C3H8O2
Ethanol	Ethyl alcohol	C2H5OH

Table 3.1: Approved antifreeze

i NOTE

The output data of the heat pumps is recorded with ethylene glycol (25%). Propylene glycol and ethyl alcohol can also be used, but we currently have no measurements for the impact on output and coefficient of performance.

The following antifreeze is not approved due to lack of long-term experience:

- "Thermera", which is manufactured with a betaine base and is controversy with regard to environmental aspects
- "Tyfo-Spezial without corrosion inhibitors.", as this antifreeze contains non-ferrous metals (e.g. copper)
- "Tyfo Spezial with corrosion inhibitors", as this antifreeze has not been officially approved by our suppliers and is so aggressive, that it causes corrosion on the paneling in the event of leaks.

⚠ ATTENTION!

No claim is made that this list is complete

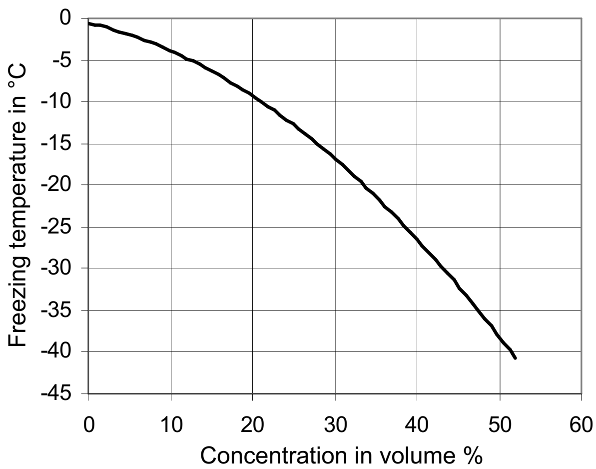


Fig. 3.1: Freezing curve of a monoethylene glycol/water mixtures in relation to the concentration

Pressure protection

Brine temperatures between approx. -5°C and +20°C can occur when heat is exclusively extracted from the ground. These fluctuations in temperature result in a change in volume of approx. 0.8 to 1% of the total volume of the system. In order to keep the operating pressure constant, an expansion vessel with a primary pressure of 0.5 bar and a maximum operating pressure of 3 bar is necessary.

⚠ ATTENTION!

For protection against overflowing, a tested membrane safety valve should be installed. The air outlet pipe of the safety valve must, according to DIN EN 12828, end in a collecting basin. To monitor pressure, a pressure gauge with minimum and maximum pressure designation is necessary.

Filling the system

The system should always be filled in the following order.

- Mix the required concentration of antifreeze and water in an external container.
- Check the antifreeze/water concentration with an antifreeze tester for ethylene glycol.
- Fill the brine circuit (at least 2 bar to a maximum of 2.5 bar)
- De-aerate the system (install a micro-bubble separator)

⚠ ATTENTION!

Even following lengthy operation of the brine circulating pump, filling the brine circuit with water and then adding antifreeze does not create a homogenous mixture. The unmixed water column freezes in the evaporator and destroys the heat pump!

Relative pressure drop

The pressure drop of brine is dependent on the temperature and the mixture. The pressure drop of the brine increases with sinking temperatures and increased concentrates of monoethylene glycol.

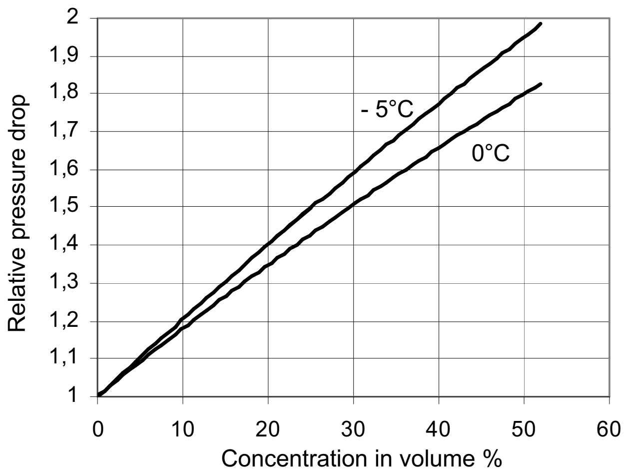


Fig. 3.2: Relative pressure drop of a monoethylene glycol / water mixture compared with water, dependent upon the concentration at 0 °C and –5 °C

Pipe DIN 8074 (PN 12.5) [mm]	Volume per 100 m [l]	Antifreeze per 100 m [l]	Maximum brine flow rate [l/h]
25 x 2.3	32.7	8.2	1,100
32 x 2.9	53.1	13.3	1,800
40 x 3.7	83.5	20.9	2,900
50 x 4.6	130.7	32.7	4,700
63 x 5.8	207.5	51,9	7,200
75 x 6.9	294.2	73.6	10,800
90 x 8.2	425.5	106.4	15,500
110 x 10	636	159	23,400
125 x 11.4	820	205	29,500
140 x 12.7	1,031	258	40,000
160 x 12.7	1,344	336	50,000

Table 3.2: Total volume and quantity of antifreeze per 100 m pipe for different types of PE pipe and frost protection down to –14 °C

3.1.4 Parallel connection of brine-to-water heat pumps

When connecting brine-to-water heat pumps in parallel, it is important to ensure that no unwanted fluid flows occur in the brine circuit in individual heat pumps

If only one heat pump is in operation, wrong fluid flows may be caused in the brine circuit by the heat exchanger of the second heat pump if a check valve is missing. To help prevent this, a check valve must be installed in the flow after each brine circuit pump.

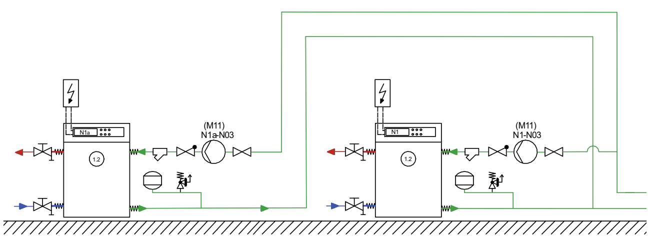


Fig. 3.3: Parallel connection of brine-to-water heat pumps

i **NOTE**

The check valve is not included in the brine accessories package and must be supplied on site.

A similar unwanted fluid flow can also occur when using a passive cooling station. Here too, a check valve must be installed after every brine circulating pump. This must also be supplied on site.

3.2 Ground heat collector

The energy stored in the ground comes almost exclusively from the surface of the earth. Precipitation and solar radiation are the main sources of this energy. Thus, nothing should be built on top of collectors and the surface should not be sealed. The inflow of heat from the interior of the earth is less than 0.1 W/m^2 and can, therefore, be disregarded.

i **NOTE**

The maximum annually extracted energy is 30 to 50 kWh/m² for sandy soil and 50 to 70 kWh/m^2 for cohesive ground.

3.2.1 Installation depth

In cold regions, the ground temperature at a depth of 1 m can drop to freezing point even without heat being extracted. The minimum temperature at a depth of 2 m is approx. 5 °C. This temperature rises with increasing depth, although the heat flow from the Earth's surface decreases. Therefore, if the collectors are laid at too great a depth, it cannot be guaranteed that any ice will thaw in the spring. Thus, the installation depth should be approx. 0.2 to 0.3 m beneath the maximum frost line. For most regions, this is between 1.0 and 1.5 m.

3.2.2 Clearance

When determining the clearance d_a between pipe runs, care must be taken to ensure that the ice radii which form around the pipe coils have melted sufficiently, after a frost period, to allow precipitation to drain, thus preventing waterlogging.
The recommended installation clearance is between 0.5 and 0.8 m, depending on the ground conditions and the climatic region.

- The longer the maximum duration of the frost period, the greater the installation clearance and the required area should be.

3.2.3 Collector surface and pipe length

In ground which is free of stones, PE-100 pipes can be used. In ground which contains stones, the use of cross-linked pipes made of Polyethylene, e.g. PE-X... with an external diameter of 32 mm is recommended due to their higher impact strength.

The area required for a horizontally-installed ground collector depends on the following factors:

- Refrigerating capacity of the heat pump
- Ground type and ground humidity content and climatic region
- Maximum duration of the frost period

NOTE

Chapt. 3.2.6 on page 41 gives standard values for dimensioning ground heat collectors.

1. Step: Heat output of the heat pump as calculated in the design point (e.g. B0/W35)

2. Step: Calculation of the refrigeration capacity by deducting the electric power consumption in the design of the heat output.

			Example: SI 14TU
$\dot{Q}_0$	=	$\dot{Q}_{HP} - P_{el}$	
$\dot{Q}_{HP}$	=	**Heat output of the heat pump**	**13.9 kW**
P_{el}	=	**Electr. power consumption of the heat pump as calculated in the design point**	**2.78 kW**
$\dot{Q}_0$	=	**Refrigerating or abstraction capacity of the heat pump from the ground as calculated in the design point**	**11.12 kW**

3. Step: Select specific abstraction capacity depending on the ground type from Table 3.2

ATTENTION!

For installing ground collectors in trenches, a pipe depth of 1.25 m should not be exceeded in order to ensure lateral protection. Risk of spillage!

- In the case of poor ground thermal conduction (i.e. sand), the installation clearance should be reduced (with a comparable horizontal surface), thereby increasing the total pipe lengths.

NOTE

In cold regions with standard outside temperature below -14 °C (e.g. south Germany), an installation clearance of approx. 0.8 m is required.
In warmer regions with standard outside temperatures of -12 °C and higher, the installation clearance can be reduced to approx. 0.6 m.

NOTE

In low mountain range locations in heights of approx. 900 m to 1000 m above sea level, the abstraction capacities are very low and the use of ground heat collectors is not recommended.

Ground type	Specific abstraction capacity for 1,800 hrs
Dry, non-cohesive ground (sand)	approx. 10 W/m
Loam / silt	approx. 19 W/m
Sandy clay	approx. 21 W/m

Table 3.3: Specific abstraction capacities

4. Step: Calculation of the required pipe length

Refrigerating capacity from the second step = 11.12 kW
Ground type loam / silt

Pipe length L = 11120 W / 19 W/m = 585.3 m

=> 6circuits of 100 m are selected

5. Step: The collector surface is calculated from the pipe length and the clearance

Collector surface A = L (pipe length) * b (clearance)

The required clearance at a location in southern Germany is 0.8m. 0.8m is selected

Collector surface A = 600m * 0.8m = 480m²

NOTE

The calculated minimum pipe length is, in practice, rounded up to a full 100 m circuit.

3.2.4 Brine collector and brine circuit manifold installation

Brine circuit manifolds easily and safely connect borehole heat exchangers or ground heat collectors with heat pumps. In general, a water/glycol mixture (brine) is used as the heat transfer medium. The brine flows from the collectors or heat exchanger pipes via the brine circuit manifold to the heat pump and back again via the brine collector in a closed circuit.

The brine collector or brine circuit manifold must be installed depending on the number of brine circuits to be filled (see Fig. 3.4 and Fig. 3.5). The collector and the manifold are both equipped with ball valves with which the individual collector or heat exchanger circuits can be completely shut off (e.g. in the event of a leakage). The PE pipes of the collectors or heat exchangers can be directly mounted on the ball valves with the premounted clamping ring fittings.

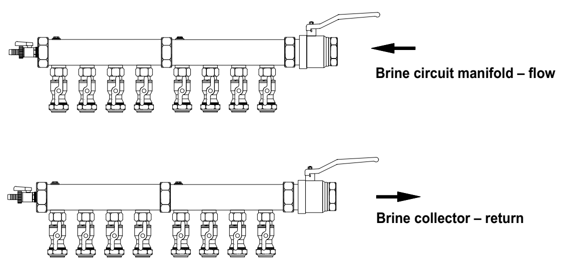


Fig. 3.4: Mounting a brine circuit manifold with a maximum of 8 circuits

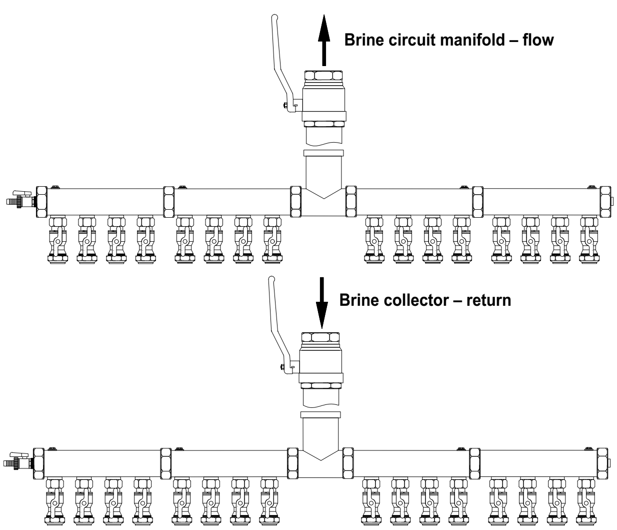


Fig. 3.5: Mounting a brine circuit manifold with a maximum of 16 (2x8) circuits

Various different points must be taken into account when installing the brine circuit manifold:

- Mount the brine circuit manifold on a duct or building wall (e.g. using a wall bracket).
- The collector or heat exchanger pipes must be inserted into the manifold from below in a bend (without tension), so that it is possible to compensate any length differences occurring between the summer and winter months (tension cracks).
- Ideally, the bend should be formed using a welding sleeve.
- Outside the building, the brine circuit manifold should be mounted in accessible ducts - protected against rain water.
- For duct mounting, we recommend covering the collector or heat exchanger pipes in the ground with approximately 20 cm of sand and/or putting them on a 20 cm sand base. If a bend is used to compensate any length differences, this should be placed above ground level in this case.

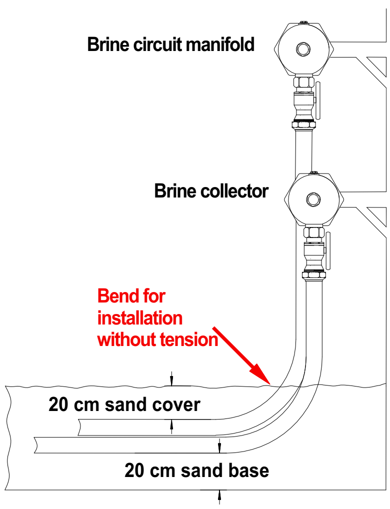


Fig. 3.6: Mounting the pipework on the brine circuit manifold

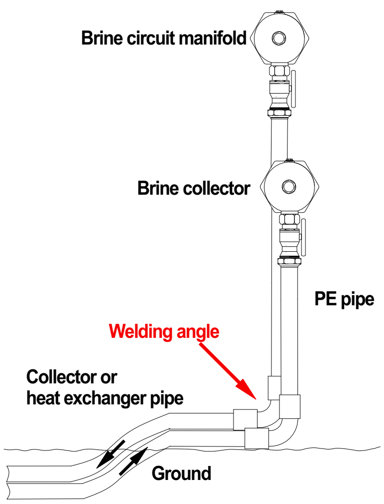


Fig. 3.7: Mounting the pipework on the brine circuit manifold with a welding angle

- If the brine circuit manifolds are mounted inside a building, the manifolds and all pipes running through the house and through the wall of the house should be insulated with steam-resistant material to prevent the formation of condensation.
- The collector pipe in each collector circuit should be no longer than 100 m and DN 32 heat exchanger pipes should be no deeper than 80 m, as pressure drops will otherwise occur.

NOTE

When installing brine circuits of equal length, hydraulic equalisation is not necessary.

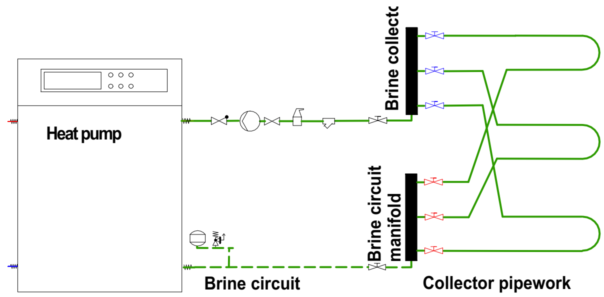


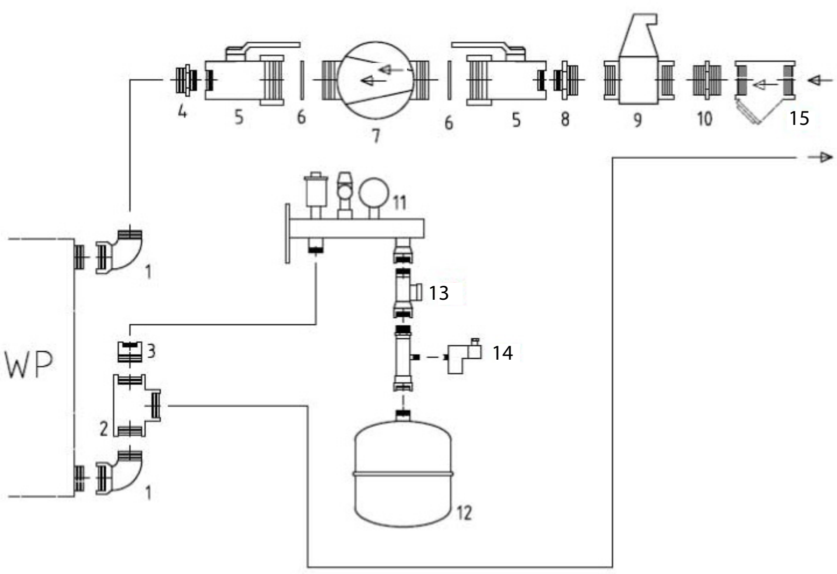
Fig. 3.8: Heat pump circuit on the heat source side

3.2.5 Installation of the brine circuit

- Every brine circuit should be provided with at least one isolating valve.
- Brine circuits must all be of the same length to ensure that each has an equal flow and abstraction capacity.
- Ground heat collectors should preferably be installed some months before the start of the heating season to allow the earth to settle.
- The minimum bend radii as stipulated by the pipe manufacturer should be observed.
- The filling and ventilation system should be installed at the site's highest point.
- All the brine circuit pipes that run through the walls of the house should be insulated with steam-resistant material to prevent the formation of condensation.
- All brine-bearing pipes must be made of corrosion-resistant material.
- The brine circuit manifold and the return collector must be installed outside the house.
- When installing the brine circulating pump of the heat source system, the range of operating temperatures of the pump listed in the installation instructions must be taken into account. The pump head position must be set in such a way that no condensation can flow into the connection box. When installing inside a building, the pump should be insulated with steam-resistant material to prevent the formation of condensation and ice. Sound insulating measures may also be necessary.
- The installation clearance between brine-bearing pipes and water pipes, sewers and buildings should be at least 0,7 m to prevent frost damage. If this clearance cannot be ensured for constructional reasons, the pipes should be sufficiently insulated in the affected area.
- Nothing should be built on top of ground heat collectors, nor should the surface be sealed in.

NOTE

If the brine circulating pump is installed outdoors, steam-resistant insulation to protect against condensation is not required.



Legend

1) Bracket
2) T-joint
3) Reducing nipple
4) Double nipple
5) Pump connection valve
6) Seal
7) Circulating pump
8) Double nipple
9) Main breather
10) Double nipple
11) Vessel connection assembly with quick ventilation, safety valve, pressure gauge
12) Expansion vessel
13) Cap valve with shut-off function
14) Low pressure switch
15) Filter insert

Fig. 3.9: Set-up of the brine circuit inlet pipe including fixtures

The main breather with micro-bubble separator should be positioned at the highest and warmest point in the brine circuit. The equipment for the brine circuit can be installed either inside or outside the building.

NOTE

The brine circuit cable and fixtures must be fitted with diffusion-proof insulation. The function of the individual components must not be restricted.

NOTE

The dirt trap included in the scope of supply of the heat pump (mesh size 0.6 mm) protects the evaporator of the heat pump; it should be installed directly in the heat pump inflow and be cleaned after a brine circulating pump flush cycle of approx. 1 day.

NOTE

Insulating materials that do not absorb any moisture should be used to prevent the insulation from becoming soaked. The joints should also be glued so that no moisture can penetrate through to the cold side (e.g. brine pipe) of the insulation.

The following brine accessories packages are available:

Brine accessories package	Heat pump	Circulating pump
SZB 140E	SI 6 - 14TU	Stratos 25/1-8
SZB 180E	SI 18TU	Stratos 30/1-8
SZB 220E	SI 22TU	Stratos 30/1-12
SZB 250	SI 24TE SIH 2TE	Top-S 40/10
SZB 300	SI 30TE	Top-S 40/10
SZB 400	SI 37TE SIH 40TE	Top-S 40/10
SZB 500	SI 50TE	Top-S 50/10
SZB 680	SI 6 - 11TE SI(H) 6 - 11TE	Top-S 25/7.5
SZB 700	SI 17TE	Top-S 30/10
SZB 750	Si 75TE	Top-S 65/13
SZB 1000	SI 100TE	Top-S 65/13
SZB 1300	SI 130TE	Top-S 65/15

Table 3.4: Brine accessory packages for different heat pumps

NOTE

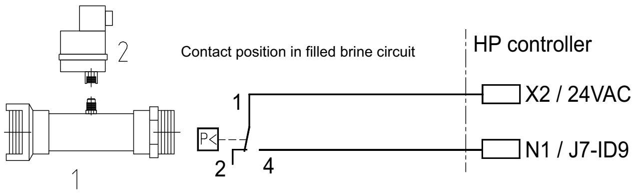
The brine accessory packages SZB 140E to SZB 220E include an electronically controlled brine circulating pump, which can be activated by the heat pump manager WPM EconPlus via a 0 - 10 V signal.

ATTENTION!

For borehole heat exchangers, the free compressions specified in the device information must be taken into account (max. heat exchanger depth for DN 32 is 80 m).

Insufficient brine solution and leakage

A "low-pressure switch" (available as an accessory) can be installed in the brine circuit to diagnose a lack of fluid, a leakage in the brine circuit or to comply with the regulations of the local authorities. In the event of a drop in pressure, the low-pressure switch sends a signal to the heat pump manager, which is then either indicated in the display or blocks the heat pump.



1) Section of pipe with internal and external threads
2) Pressure switch with connector and connector seal

Fig. 3.10: Low-pressure switch for the brine circuit (assembly and wiring)

The piece of pipe shown in the drawing must be installed in the brine circuit between the cap valve and the expansion vessel. The pressure switch must be connected to the connecting stub on the section of pipe. The cap valve with shut-off function enables the low-pressure switch to be installed and removed easily and checked for correct function. When carrying out the function check on the low-pressure switch, hold the drain valve open until the pressure switch shuts off the heat pump manager and the heat pump via a digital signal in response to the pressure drop in the brine circuit. Catch the brine fluid in a suitable container. If the low-pressure switch does not shut off the heat pump during obvious pressure drop, the function of the sensor should be checked and the sensor replaced if necessary. Once the check is complete, fill the brine circuit again with the collected brine fluid Then check the brine circuit for leaks and check the function of the heat pump.

3.2.6 Standard dimensioning of ground heat collectors.

The data in the dimensioning table *Table 3.5 on page 42* are based on the following assumptions:

- PE pipe (brine circuit): Pipe DIN 8074
  32 x 2.9 mm – PE 100 (PN 12.5)
- PE feeder pipe between the heat pump and the brine circuit according to DIN 8074:
- Nominal pressure PN 12.5 (12.5 bar)
- Specific abstraction capacity of the ground approx. 25 W/m^2 for 0.8 m clearance
- Brine concentration: minimum 25% to maximum 30% antifreeze (glycol-based)
- Pressure expansion vessel: 0.5 bar primary pressure

NOTE

With the Dimplex operating cost calculator, a ground heat collector for brine-to-water heat pumps can now be configured for every region in Germany.
The latest version of the operating cost calculator and further information on this topic can be found at
www.dimplex.de/online-planer/wp-rechner.

NOTE

The design of the brine circulating pumps is only valid for section lengths up to a maximum of 100 m and the given number of brine circuits!

An increase in the number of brine circuits and a reduction in the section lengths does not have a critical effect on the pressure drops if all other parameters remain unchanged. For varying framework conditions (e.g. the specific abstraction capacity, brine concentration), the total permissible pipe length for the flow and return between the heat pump and the brine circuit manifold must be dimensioned again.

The quantity of antifreeze listed in *Table 3.2 on page 36* is based on the given wall thicknesses. The amount of antifreeze should be increased for smaller wall thicknesses in order to maintain the minimum brine concentration of 25%.

Heat pump	Circulating pump same type of model or similar	Circulating pump	Alternative	Minimum brine flow rate	Refrigeration capacity	Pipe length ground collector[1]	Number of brine circuits	Pressure expansion vessel	Permissible total pipe lengths for flow and return between the heat pump and brine circuit manifold									Motor protection
									32 x 2.9	40 x 3.7	50 x 4.6	63 x 5.7	75 x 6.8	90 x 8.2	110 x 10	125 x 11.4	140 x 12.7	
				m^3/h	kW	m		l	m	m	m	m	m	m	m	m	m	A
SI 5ME	Wilo	TOP-S 25/7.5	UPS 25-60	1.2	3.7	200	2	8	50									[2]
SI 7ME / SIH 6ME	Wilo	TOP-S 25/7.5	UPS 25-60	1.7	4.7	300	3	8	15	40	110							[2]
SI 9ME / SIH 9ME	Wilo	TOP-S 25/7.5	UPS 25-80	2.3	6.9	400	4	12		20	65							[2]
SIK 11ME	Wilo	TOP-S 25/7.5	UPS 25-80	3	9.1	500	5	12		10	70							[2]
SI 11ME / SIH 11ME	Wilo	TOP-S 25/7.5	UPS 25-80	3	8.3	500	5	12		10	70							[2]
SI 14ME	Wilo	TOP-S 25/7.5	UPS 25-80	3.5	10.9	600	6	18			20	70						[2]
SIK 16ME	Wilo	TOP-S 25/7.5	UPS 25-80	3.5	11.3	700	7	18			20	70						[2]

1. according to Chapt. 3.2.6 on page 41
2. With integrated full motor protection or blocking current-resistant motor

Heat pump	Output (B0W35)	Circulating pump	Alternative Grundfos	Minimum volume flow	Refrigerating capacity [1]	Pipe length collector at 20 W / m [2]	Pressure expansion vessel	Brine circuits	Permissible total pipe lengths for flow and return between the heat pump and brine circuit manifold									Motor protection
									32 x 2.9	40 x 3.7	50 x 4.6	63 x 5.7	75 x 6.8	90 x 8.2	110 x 10	125 x 11.4	140 x 12.7	
				m^3/h	kW	m	l		m	m	m	m	m	m	m	m	m	A
SI 6TU	1.3	WILO Stratos 25/1-8	UPS 25-60	1.45	5.0	300	8	3	20	100								
SI 8TU	1.67	WILO Stratos 25/1-8	UPS 25-80	1.9	6.4	400	12.0	4	10	35	100							
SI 11TU	2.22	WILO Stratos 25/1-8	UPS 25-80	2.6	8.7	500	12.0	5		10	70							
SI 14TU	2.78	WILO Stratos 25/1-8	UPS 25-80	3.4	11.1	600	18.0	6			20	70						
SI 18TU	3.7	WILO Stratos 30/1-8	UPS 32-80	4.3	13.8	700	18.0	7			100	300						
SI 22TU	5.10	WILO Stratos 30/1-12	UPS 32-120	5.5	18.0	900	18.0	9			80	270						1.1
SI 24TE	5.81	WILO TOP-S 40/10	UPS 40-120 F	5.6	18.0	900	18.0	10			100	300						1.2
SI 30TE	6.91	WILO TOP-S 40/10	UPS 40-120 F	7.0	24.0	1,200	18.0	13				150	400					1.2
SI 37TE	8.17	WILO TOP-S 40/10	UPS 40-120 F	8.5	29.0	1,500	18.0	15				120	350					1.2
SI 50TE	10.60	WILO TOP-S 50/10	UPS 50-120 F	12.8	36.0	1,800	25.0	20					70	180				1.8
SI 75TE	17.29	WILO TOP-S 65/13	UPS 65-120 F	20.5	58.0	2,900	35.0	32						120	300			3.0
SI 100TE	21.21	WILO TOP-S 65/13	UPS 65-120 F	24.0	75.0	3,800	50.0	39							180	300		3.0
SI 130TE	52.86	WILO TOP-S 65/15	UPS 65-180 F	34.0	97.0	4,900	50.0	53								140	300	3.5
SIH 20TE	4.86	WILO TOP-S 40/10	UPS 40-120 F	5.1	17.0	900	18.0	17			100	300						1.2
SIH 40TE	8.35	WILO TOP-S 40/10	UPS 40-120 F	8.8	29.0	1,500	18.0	19				120	350					1.2
SIH 6TE / SIK 7TE	1.66	WILO TOP-S 25/7.5	UPS 25-60	1.7	5.5	300	8.0	3	15	40	110							3.0
SIH 9TE / SIK 9TE	2.14	WILO TOP-S 25/7.5	UPS 25-80	2.3	7.5	400	8.0	4		20	65							3.0
SIH 11TE / SIK 11TE	2.79	WILO TOP-S 25/7.5	UPS 25-80	3.0	9.0	500	12.0	5		10	70							3.0
SIK 14TE	3.37	WILO TOP-S 25/7.5	UPS 25-80	3.5	11.0	600	18.0	6			20	70						3.0

1. According to the compressor manufacturer at B0/W35.
2. according to Chapt. 3.2.6 on page 41

Table 3.5: Dimensioning table for brine-to-water heat pumps for a specific abstraction capacity of the ground of 20 W/m^2 with a ground heat collector. (assumptions: brine concentration with 25% antifreeze, 100 m pipe section lengths in the individual brine circuits, pipes made of 100 (PN12.5), 32 x 2.9mm in accordance with DIN 8074 and 8075.

3.3 Borehole heat exchangers

When implementing a borehole heat exchanger system, a heat exchanger system is constructed in boreholes, usually with a depth of between 20 m to 100 m in the ground. When double U pipes are used, there is an estimated average heat source output of approx. 50 W per metre of heat exchanger length. However, exact dimensioning depends on the respective geological and hydro-geological conditions, which are generally unknown to the heating technician. The design should, therefore, be left to a drilling company accredited with the seal of approval from the International Heat Pump Association or authorised according to DVGW W120. In Germany, the information in the Association of German Engineers' (VDI) publication VDI -4640 Parts 1 and 2 should be taken into consideration.

Ground temperatures

The ground temperature below a depth of approx. 15 m is around 10 °C all year round (see Fig. 3.11 on page 43).

NOTE

The extraction of heat causes the temperatures in the pipe to drop. The design must ensure that no permanent brine outlet temperatures fall below 0 °C.

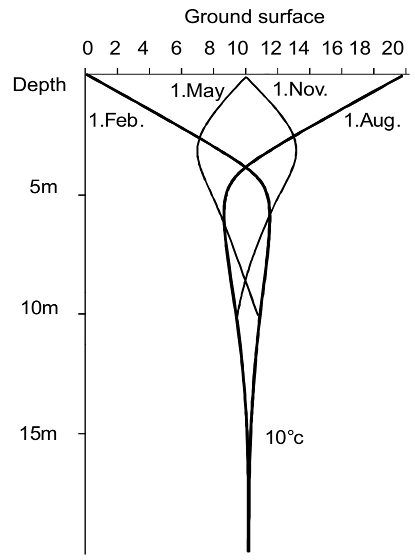


Fig. 3.11: Illustration of the temperature curve at different depths underground in relation to the seasonal, mean temperature values on the Earth's surface.

3.3.1 Design of borehole heat exchangers

Borehole heat exchangers must always be designed for the geothermal planning office. An approximate estimation, even in small output ranges, is not permissible for ground heat exchangers. This is necessary, as the abstraction capacity is based on the composition of the ground and the water-bearing layers. These factors can only be determined on-site by the company carrying out the work.

NOTE

When planning and designing ground heat exchangers, the legal requirements in the individual countries must be taken into account.

Long-term, calculated simulation of low gears makes it possible to identify the long-term effects and thus take these into consideration during dimensioning.

NOTE

When designing borehole heat exchanger fields as a heat source, it is important to ensure that the size of the borehole heat exchanger field is selected based on the annual heat consumption in the building. This is especially important with bivalent systems. Normally, the abstraction capacity of the borehole heat exchanger field is dimensioned for an annual heat pump runtime of 1,800 to 2,400 hours. As the heat pump runtime is higher with bivalent systems, the borehole heat exchanger fields for such systems must be of a larger scale.

3.3.2 Preparation of boreholes

The clearance between the heat exchangers should be at least 6 m so that reciprocal interference is kept to a minimum and regeneration is guaranteed in the summer. If several heat exchangers are required, these should not be laid out parallel to the direction of ground water flow, but rather perpendicular to it (see Fig. 3.12 on page 43).

NOTE

The same rules as for ground heat collector systems apply to the brine concentration, the materials used, the layout of the manifold shaft and the installation of the pump and expansion vessel.

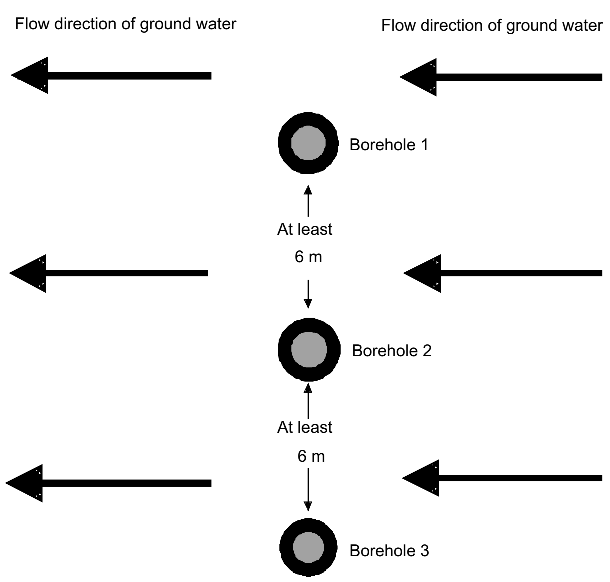


Fig. 3.12: Layout and minimum clearances between borehole heat exchangers in relation to the direction of the ground water current

Fig. 3.13 on page 44 shows a cross section through a double U pipe of the type normally used for heat pumps.

For this type of heat exchanger, a bore hole must first be drilled with a radius of r_1. Four heat exchanger pipes and a back-fill pipe are inserted, and the borehole is then back-filled with a cement/ bentonite mixture. The heat exchanger fluid flows downwards in two of the pipes and flows upwards again in the other two. The pipes are connected at the lower end with a borehole head, creating a closed-loop heat exchanger circuit.

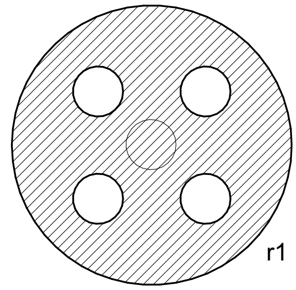


Fig. 3.13: Cross section of a double U pipe with back-fill pipe

NOTE

When using brine circuit equipment or heat pumps with an integrated brine circulating pump, the pressure drops of the borehole heat exchanger must be determined and compared with the free compression of the brine circulating pump. To avoid unnecessarily high pressure drops, DN 40 pipes should be used for borehole heat exchanger depths of more than 80 m.

3.3.3 Filling ground heat exchangers

Just like ground heat collectors, ground heat exchangers are generally filled with a glycol solution with a concentration of 25 - 30 %. This ensures that brine inlet temperatures of - 5°C can be easily achieved in the heat pump. The glycol portion protects the heat pump from freezing.

In some cases, however, it may be necessary to operate the ground heat exchanger with pure water without antifreeze. In this case, the brine inlet temperature must not fall below 0 °C, as the water could freeze in the brine pipe, which would cause damage to the pipe. A number of different points must therefore be taken into account when operating ground heat exchangers with water:

- A water-to-water heat pump is used instead of a brine-to-water heat pump
- The minimum brine outlet temperature must not be lower than 4 °C in this case
- The transmission capacity of the heat exchanger reduces as a result of the higher temperatures. The number of heat exchangers required approximately doubles compared to a ground heat exchanger with water/glycol.

3.4 Additional heat source systems for ground heat usage

As an alternative to ground heat collectors, other types of heat source systems are offered, such as geothermal baskets, trench collectors, energy poles, coil collectors etc..
These heat source systems must be designed in accordance with the manufacturer or supplier instructions. The manufacturer must guarantee the long-term functioning of the system based on the following data:

- Minimum permissible brine temperature
- Refrigerating capacity and brine flow rate of the installed heat pump
- Annual operating hours of the heat pump

Additionally, the following information should be made available:

- Pressure drop with specified brine flow rate for designing the brine circulating pump
- Possible impact on the vegetation
- Installation requirements

NOTE

Experience shows that the abstraction capacities of classic ground heat collectors only differ slightly from other systems, since the energy stored in 1 m^3 of ground is limited at 50 to 70 kWh/a.

Possible optimisation of the abstraction capacities depend first and foremost on the climate conditions and the ground type, and not on the type of heat source system.

3.5 Heat source water with intermediate heat exchanger

3.5.1 Use of water heat source in the event of contamination

To enable indirect use of the heat source water, brine-to-water heat pumps can be operated via an intermediate circuit with additional stainless steel heat exchangers. To this end, an additional heat exchanger is installed in the heat source circuit of the heat pump and the intermediate circuit is filled with monoethylene glycol.

The external stainless steel heat exchanger makes it possible to use the heat source ground water, even in areas with relatively high water soiling levels. In areas with water temperatures below 13 °C throughout the year, no water analysis is required with regard to corrosion.

ATTENTION!

If the limit values for iron (Fe to 0.2 mg/l) or manganese (Mn to 0.1 mg/l) are exceeded, there is a risk of sedimentation forming in the heat source system. This also applies when using stainless steel heat exchangers.

NOTE

An online planner, which can be used to calculate the seasonal performance factor (including intermediate heat exchangers), is available at www.dimplex.de/betriebskostenrechner.

A number of different packages are available, consisting of heat pump, heat exchanger, matching brine accessories and a safety thermostat to help protect the heat pump from freezing. In this case, the heat pump output values are listed differently under operating point B7/W35. This corresponds to a brine inlet temperature of 7 °C with an assumed water temperature of 10 °C and a grade or spread via the heat exchanger of 3 K.

Order reference	Heat pump	Heat exchanger	Brine circuit accessories	Heat output with B7/W35	COP with B7/W35
WSI 36TE	SI 30TE	WTE 30	SZB 300	36 kW	4.9
WSI 44TE	SI 37TE	WTE 37	SZB 400	44 kW	5.2
WSI 55TE	SI 50TE	WTE 50	SZB 500	55 kW	4.9
WSI 85TE	SI 75TE	WTE 75	SZB 750	85 kW	4.9
WSI 110TE	SI 100TE	WTE 100	SZB 1000	113 kW	5.1
WSI 150TE	SI 130TE	WTE 130	SZB 1300	145 kW	4.9
WSIH 26TE	SIH 20TE	WTE 20	SZB 250	26 kW	5.0
WSIH 44TE	SIH 40TE	WTE 40	SZB 400	44 kW	4.9

Table 3.6: Heat pump packages with intermediate heat exchanger

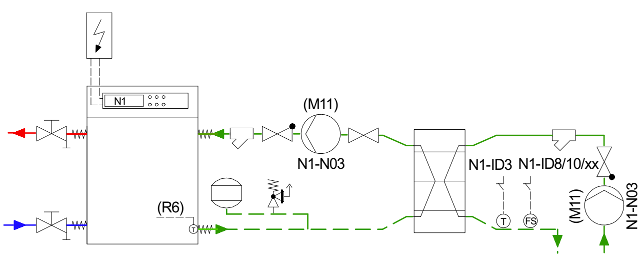


Fig. 3.14: Heat pump with intermediate heat exchanger

The flow rate switch in the primary circuit (FS) prevents the heat pump from switching on if the volume flow of the cooling water or ground water pump is not present.

The intermediate heat exchanger circuit must be filled with antifreeze for brine-to-water heat pumps (at least -14 °C).

The brine circuit should be equipped with a circulating pump and safety valves in the same way as for standard ground heat collectors and borehole heat exchangers. The circulating pump should be dimensioned in a way which ensures that the intermediate heat exchanger does not freeze.

If a brine-to-water heat pump is used, the temperatures in the secondary circuit can fall below 0°C. The intermediate heat exchanger must be protected using an additional frost protection thermostat (T). This must be installed at the water outlet of the primary circuit in order to ensure that the heat exchanger does not freeze. When the thermostat is switched off, the heat pump is blocked via digital input ID3 of the heat pump manager. The thermostat should also be passed on as an error message to the building management system where prevent the heat pump from surging. The switch-off point of the thermostat (e.g. 4°C) depends on the system configuration, the measurement tolerances and the hystereses.

The maximum permissible flow temperature on the heat source side of a brine-to-water heat pump is 25 °C. There are a number of different ways to prevent the heat pump from switching off due to excessively high brine inlet temperatures.

ATTENTION!

The terminal assignment of the heat pump manager specified in the relevant installation instructions must be complied with!

NOTE

For the installation of a brine-to-water heat pump with intermediate heat exchanger, the water flow in the primary cycle must be at least 10% above the flow rate of the secondary circuit.

3.5.2 Expanding the operating temperature range

If the heat source temperatures fluctuate, it is advisable to use a brine-to-water heat pump, as they permit minimum brine outlet temperatures of -9 °C. By comparison, water-to-water heat pumps switch off from a minimum water outlet temperature of 4 °C. The maximum brine inlet temperature for both brine-to-water and water-to-water heat pumps is 25 °C. Various different measures can be used to ensure that the operating limits are reached and not exceeded.

i NOTE

The efficiency of the heat pump is reduced if the brine inlet temperature falls.

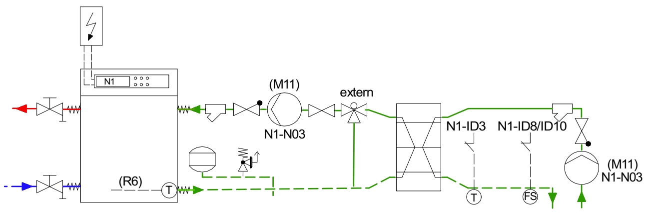


Fig. 3.15: Heat pump with three-way valve in the brine circuit

Version 1 - heat pump with three-way valve

A thermostat-controlled three-way valve is installed in the brine circuit. If the brine inlet temperature rises above 25 °C, a partial volume flow of the brine return is added to the brine flow via the mixer. The mixer is controlled via an external controller.

Version 2 - heat pump with buffer tank in the brine circuit

Version 2 uses a buffer tank in the brine circuit (see Fig. 3.16 on page 46). The buffer tank is charged with pump P1 via an external control. When a minimum temperature of 3 °C is reached in the buffer tank, the pump is activated and charged. From a maximum temperature of 24 °C, the pump P1 switches off. The heat pump manager activates the heat source pump (primary circulation pump M11) in the brine circuit. If the temperature sensor (R6) registers a temperature below 3 °C or a temperature of 25 °C, the heat pump manager switches the heat source pump off. The brine circuit must be filled with glycol with a concentration of at least 25%.

i NOTE

Low brine temperatures in the buffer tank and the pipework can result in condensate failure on the buffer tank. The buffer tank must therefore be fitted with diffusion-proof insulation on-site.

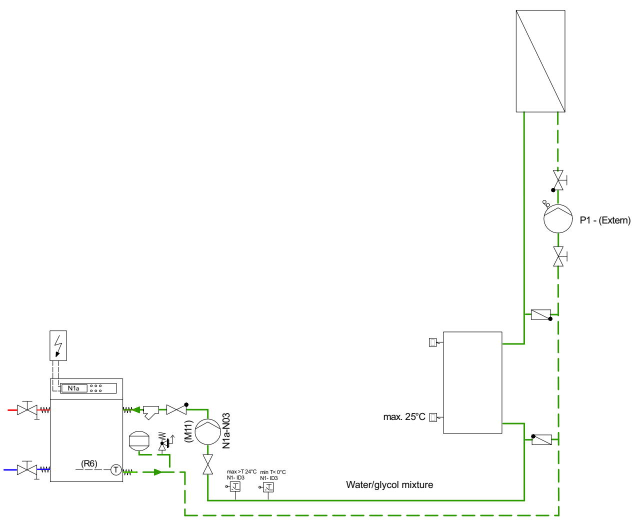


Fig. 3.16: Heat pump with buffer tank in the brine circuit

3.6 Heat source absorber systems (indirect use of air or solar energy)

Brine temperature range -15...+ 50 °C

Operating range of the brine-to-water heat pump -5 to +25 °C

Availability

Restrictions due to weather influences and limited surfaces possible.

Types of operation

- Bivalent
- Monovalent in combination with an additional ground heat collector

Development costs

- Absorber system (energy roof, pipe bundle, solid absorber, energy fence, energy tower, energy stack, etc.)
- Ethylene glycol or propylene glycol-based brine in a frost-proof concentration
- Pipework and circulating pump
- Construction work

Pay special attention to:

- Building requirements
- Effects of the weather

Dimensioning absorber systems

Individual constructions vary considerably, so that the factory specifications should normally be consulted when dimensioning roof absorbers, energy towers and energy fences.

Experience has shown that the following data can be used as a basis:

- The absorber surface should be designed according to the specified off-peak (night time) output of the absorber.
- Even at temperatures over 0 °C, rain, dew or snow can freeze on the surface of the absorber when the temperature of the brine is very low. This could have a negative effect on the heat flow rate.
- Monovalent operation is only possible in combination with the utilisation of ground source heat.
- With the use of solar energy, brine can reach temperatures of 50 °C or more in the transition period. Such temperatures greatly exceed the operating range of the heat pump.

⚠ ATTENTION!

If the heat source temperature can rise to over 25 °C, then a temperature-controlled mixer is required that, for temperatures over 25 °C, adds a partial volume flow of the cooling water return flow to the cooling water flow. (see Chapt. 3.5.2 on page 46)

Brine concentration

Due to the low outdoor temperatures, frost protection down to –25 °C is necessary for roof absorbers, energy fences, etc. The brine concentration for this system is 40%. When designing the brine circulating pump, it should be taken into consideration that the higher the brine concentration, the higher the pressure drops.

Filling the system:

The system should be filled as described in Chapt. 3.1.3 on page 35.

Design of the expansion vessel:

The brine temperatures vary between approx. –15 °C and approx. +50 ° C for absorber-only operation. An expansion vessel must be installed in the vicinity of the heat source system to accommodate these large temperature fluctuations. The primary pressure should be set to correspond to the height of the system. The maximum overpressure is 2.5 bar.

Air pressure absorber

Brine concentration:	≈	40%
Relative pressure drop	≈	1.8

i NOTE

If commissioning is carried out by the after-sales service and the anti-freeze contains 30% monoethylene glycol, the lower operating limit can be expanded to -10 °C!

4 Water-to-water heat pump

4.1 Ground water as a heat source

Temperature range of the ground water 7 to 12 ° C

Operating range of the water-to-water heat pump 7 to 25 °C

Availability

- Year round

Types of operation

- Monovalent
- Mono energy
- Bivalent (alternative, parallel)
- Bivalent-renewable

Development costs

- Approval process (local water authority)
- Extraction wells / absorption well with air-tight seal on the wellheads
- Water quality (water analysis)
- Pipework
- Well pump
- Excavation/construction work

Maintenance information

To guarantee safe operation of the heat pump, maintenance work must be carried out on the heat pump at regular intervals. The following work can be carried out with no special training:

- Cleaning inside the heat pump
- Cleaning the filter in the primary circuit

The heat pump must also be checked for leaks and the function of the refrigerant circuit checked at regular intervals.

i NOTE

Further information of country-specific standards relating to leakage tightness tests on heat pumps is available at www.dimplex.de/dichtheitspruefung.

i NOTE

Further information on heat pump maintenance is available in the heat pump installation instructions.

Work on components carrying refrigerant may only be carried out by personnel with relevant training.

Tapping the ground water heat source

Starting at a well depth of between 8 and 10m, the ground water heat source is suitable for monovalent heat pump operation, as it is only susceptible to minor temperature fluctuations throughout the year (7-12°C). Approval is required from the appropriate water authorities for heat extraction from ground water. Permission is generally given outside of water protection zones. However, permission is dependent on certain conditions, e.g. a specified maximum amount of water that may be withdrawn, or a water analysis. The amount of water that may be withdrawn depends on the heat output. *Table 4.1 on page 49* lists the necessary withdrawal quantities for the operating point W10/W35.

A well system with extraction and absorption wells should be designed and constructed by a drilling company accredited with the seal of approval from the International Heat Pump Association or authorised according to DVGW W120. In Germany, the information in the Association of German Engineers' (VDI) publication VDI 4640 Parts 1 and 2 should be taken into consideration.

i NOTE

Two wells are required for the withdrawal of ground water, an “extraction well” and an “absorption well”. For economic reasons, for heat pumps with a heat output of up to 30 kW, ground water should not be pumped from depths greater than 15 m.

Heat pump	Well pump (recommended with standard)	Circulating pump with bad water quality and use of an intermediate circuit with plate heat exchanger	Well pump compression bar	Cold water flow of HP m^3/h	Heat output of the heat pump kW	Refrigerating capacity of the heat pump kW	Pressure drop of the evaporator Pa	Well diameter from Inch	Motor protection A
WI 9ME	Grundfos SP 2A-6	Not required[1]	2.4 at	2	8.3	6.7	6,200	4"	4
WI 14ME	Grundfos SP 3A-6	Not required[1]	2.3 at	3.3	13.6	10.9	19,000	4"	4

Heat pump	Stainless steel coil heat exchanger	Well pump (recommended with standard)	Circulating pump with bad water quality and use of an intermediate circuit with plate heat exchanger	Well pump compression bar	Cold water flow heat pump m^3/h	Heat output of the heat pump kW	Refrigerating capacity of the heat pump kW	Pressure drop of the evaporator Pa	Well diameter from Inch	Motor protection A
WI 10TU	x	UWE 200-95	Not required[1]	2.4	2.2	8.4	6.8	6,200	4	0.52/1.4
WI 14TU	x	Grundfos SP 3A-6	Not required[1]	2.7	3.1	13.3	11.1	14,000	4	1.4
WI 18TE	x	Grundfos SP 5A-4	Not required[1]	1.8	4.0	17.1	13.9	12,000	4	1.4
WI 22TE	x	Grundfos SP 5A-4	Not required[1]	1.6	5.0	21.5	17.6	20,000	4	1.4
WI 27TE	x	Grundfos SP 8A-5	Not required[1]	2.2	7.0	26.4	21.3	16,000	4	2.3
WI 50TU		Grundfos SP 17-2	Wilo Top-S 40/7[2]	1.4	11.0	49.0	40.7	13,900	6	3.4
WI 100TU		Grundfos SP 17-3	Wilo Top-S 50/7[2]	2.1	21.2	98.5	80.5	19,000	6	5.5

1. Stainless steel coil heat exchanger as standard!
2. Control via M11 output (primary pump) on the heat pump manager

Table 4.1: Dimensioning table of the minimum well pump specifications required for water-to-water heat pumps at W10/W35 for standard installation set-ups with sealed wells. The final specifications of the well pump must be agreed upon in consultation with the well constructor.

i NOTE

The overcurrent relays integrated in the heat pumps must be set during installation.

ATTENTION!

If an additional well pump is used, the protective motor switch at the site must be checked and replaced if necessary.

4.2 Water quality requirements

Irrespective of any legal regulations, the ground water should not contain any substances that could form deposits. iron (<0.20 mg/l) and manganese (<0.10 mg/l) limit values must be adhered to to prevent iron ochre sedimentation from forming in the heat source system.

Experience has shown that contamination with grains larger than 1 mm (organic components in particular) can easily cause damage. Granular material (fine sand) does not deposit if the specified water flows are adhered to.

The dirt trap included in the scope of supply of the heat pump (mesh size 0.6 mm) protects the evaporator of the heat pump; it should be installed in the heat pump inflow.

⚠ ATTENTION!

Fine, colloidal contaminants that cause the water to become turbid also tend to stick and can deposit in the evaporator, thereby impairing heat transfer. These contaminants cannot be removed cost-efficiently using a filter.

The use of surface water or water containing salt is not permissible. Your local water utility company can provide general information regarding the possible use of ground water.

a) **Water-to-water heat pumps with welded stainless steel coil heat exchangers (*Table 4.1 on page 49*)**
It is not necessary to carry out a water analysis with regard to evaporator corrosion if the annual mean temperature of the ground water is below 13 °C. In this case, only the values for iron and manganese have to be complied with (sedimentation).
At temperatures over 13 °C (e.g. waste heat recovery), a water analysis must be carried out in accordance with *Table 4.2 on page 50* and the resistance proven for the stainless steel evaporator of the heat pump. If one characteristic in the column "stainless steel" is negative "-" or two characteristics are "0", then the analysis should be considered to be negative.

b) **Water-to-water heat pumps with copper-soldered stainless steel plate heat exchanger**
Irrespective of any legal regulations, a water analysis according to *Table 4.2 on page 50* must be carried out to determine the resistance for the heat pump's copper-soldered evaporator. If one characteristic in the column "copper" is negative "-" or two characteristics are "0", then the analysis should be considered to be negative.

i NOTE

If the necessary water quality is not achieved or if this cannot be guaranteed long-term, we recommended installing a brine-to-water heat pump equipped with an intermediate circuit.

Evaluation characteristic	Concentration range (mg/l)	Copper	Stainless steel > 13°C
Substances that could form deposits (organic)		0	0
Ammonia NH3	< 2 2 to 20 > 20	+ 0 –	+ + 0
Chloride	< 300 > 300	+ 0	+ 0
Electr. conductivity	< 10 µS/cm 10 to 500 µS/cm > 500 µS/cm	0 + –	0 + 0
Iron (Fe), dissolved	< 0.2 > 0.2	+ 0	+ 0
Free (aggressive) carbonic acid	<5 5 to 20 > 20	+ 0 –	+ + 0
Manganese (Mn), dissolved	< 0.1 > 0.1	+ 0	+ 0
Nitrate (NO_3), dissolved	< 100 > 100	+ 0	+ +
PH value	< 7,5 7.5 to 9 > 9	0 + 0	0 + +
Oxygen	< 2 > 2	+ 0	+ +
Hydrogen sulphide (H2S)	< 0.05 > 0.05	+ –	+ 0
HCO3- / SO_4^{2-}	< 1 > 1	0 +	0 +
Hydrogen carbonate (HCO3-)	< 70 70 to 300 > 300	0 + 0	+ + 0
Aluminium (Al), dissolved	< 0.2 > 0.2	+ 0	+ +
SULFATE	up to 70 70 to 300 >300	+ 0 –	+ + 0
SULPHITE (SO3), free	< 1	+	+
Chlorine gas (Cl2)	< 1 1 to 5 > 5	+ 0 –	+ + 0

Table 4.2: Resistance of copper-soldered or welded stainless-steel plate heat exchangers to substances contained in the water
"+" Normally good resistance
"0" corrosion problems can arise, particularly if several factors receive a evaluation of "0".
"-" Should not be used
[< smaller than, > larger than]

4.3 Tapping the heat source

4.3.1 Direct use of water of consistently good quality

Water with temperatures between 8 °C and 25 °C can be directly used in water-to-water heat pumps if the compatibility of the ground or cooling or waste water has been proven according to *Table 4.2 on page 50*.

If the water quality is evaluated as being too poor, or if the water quality varies (i.e. in the case of a fault), a heat pump equipped with an intermediate circuit (see Chapt. 4.3.2 on page 51) must be installed.

4.3.1.1 Ground water as a heat source

Extraction well

The ground water which the heat pump uses as its heat source is extracted from the ground via an extraction well. The well output must guarantee continuous extraction to ensure the required minimum water flow rate of the heat pump.

Absorption well

The ground water cooled by the heat pump is returned to the ground via an absorption well. The absorption well must be drilled 10 - 15 m downstream from the extraction well in the direction of the ground water flow in order to ensure that the flow is not "short-circuited". The absorption well must be able to accommodate the same amount of water as the extraction well supplies.

NOTE

Because the operational reliability of the system depends on the design and construction of the wells, this work should be carried out by an experienced well constructor.

NOTE

Before commissioning the heat pump, a 48-hour test run must be carried out on the primary pump to ensure that the minimum volume flow on the heat source side can be permanently guaranteed. This must be confirmed for commissioning requests.

NOTE

A list of qualified well constructors is available at www.dimplex.de.

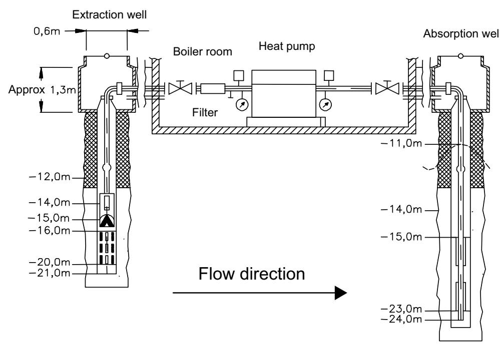


Fig. 4.1: Example for the integration of a water-to-water heat pump with extraction and absorption wells

4.3.1.2 Waste heat from cooling water as the heat source

Temperature range

For utilising water with temperatures between 8 and 25 °C, it must first be clarified whether the cooling water is available in suitable quality and quantity, and to what extent the heat generated by the heat pump can be used.

If the compatibility of the cooling and waste water is permanently ensured according to Table 4.2 on page 50, a water-to-water heat pump can be used.

ATTENTION!

If the heat source temperature can rise to over 25 °C, the temperature-controlled mixer is required that, for temperatures over 25 °C, adds a partial volume flow of the cooling water outlet to the the cooling water.

4.3.2 Indirect use of water as a heat source

If the compatibility of the water cannot be proven or if there is any danger that the water quality may change, an intermediate heat exchanger must be installed upstream to protect the heat pump. The intermediate circuit increases the operational safety, in particular if a brine-to-water heat pump is used and the secondary circuit is thus filled with brine. (Chapt. 3.5 on page 45)

A water-to-water heat pump with intermediate heat exchanger should only be used when the use of brine as a heat transfer medium is not permitted and permanent water temperatures of above 10 °C (e.g. waste heat from production processes) can be guaranteed.

NOTE

Generally, brine-to-water heat pumps should be installed in order to expand the range of operating temperatures to also include lower temperatures and thus increase operational safety. With water-to-water heat pumps, the lower operating limit is already reached at an outlet temperature of 4 °C.

4.3.3 Heat exchanger for the protection of the heat pump

The external heat exchanger must be suitable for the heat pump used as well as for the prevailing temperature level and water quality. In the simplest case, the heat exchanger consists of PE pipes which are installed directly in the cooling water, thus requiring no additional cooling water pump. This cost-efficient alternative can be used as long as the cooling water pool is large enough.

Otherwise, screwed plate heat exchangers must be used.

The heat exchanger is dimensioned according to the following parameters:

- Water quality
- Range of operating temperatures
- Refrigeration capacity of the heat pump type in use
- Primary and secondary circuit water flow

i NOTE

When using aggressive media (e.g. sea water) as a heat source, titanium plate heat exchangers must be used.

From software version "J01", the brine limit protection of a brine-to-water heat pump can be adjusted. When the standard value is raised from -8 °C to 0 °C, the heat pump is switched off at brine outlet temperatures below 0 °C.

Heat exchanger installation

For optimal heat transfer, the heat exchangers must be connected in counter flow principle. They must still be protected from soiling. To this end, a dirt trap with a mesh size of > 0.6mm must be installed in front of each heat exchanger inlet. Compensators should be used to reduce the transfer of solid-borne noise.

Maintenance of the heat exchanger

Soiling may occur on the heat exchanger depending on the hardness or soiling in the water. This reduces the output of the heat exchanger. To prevent this from happening, the heat exchanger must be cleaned in regular intervals. The so-called CIP process (Cleaning-In-Place) is used here - the heat exchanger is rinsed on-site with a mild acid, such as formic acid, itric acid or acetic acid, to remove any deposits.

i NOTE

It is advisable to check the heat exchanger for soiling at least every two years.

4.3.3.1 Stainless steel plate heat exchangers WTE 20 to WTE 40

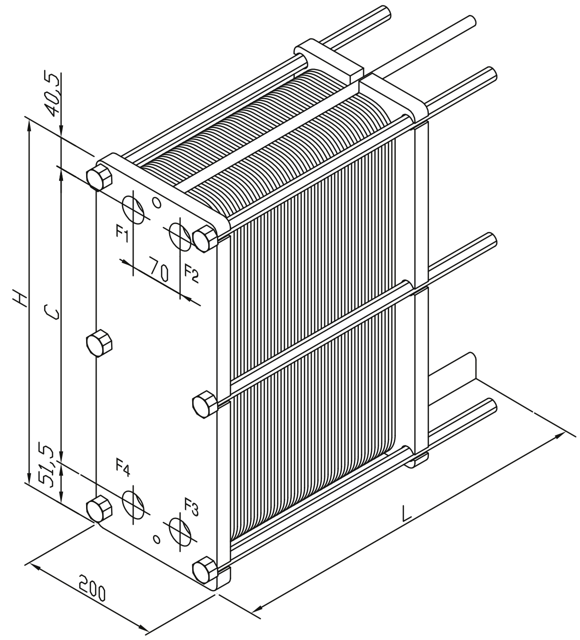


Fig. 4.2: WTE 20 – WTE 37

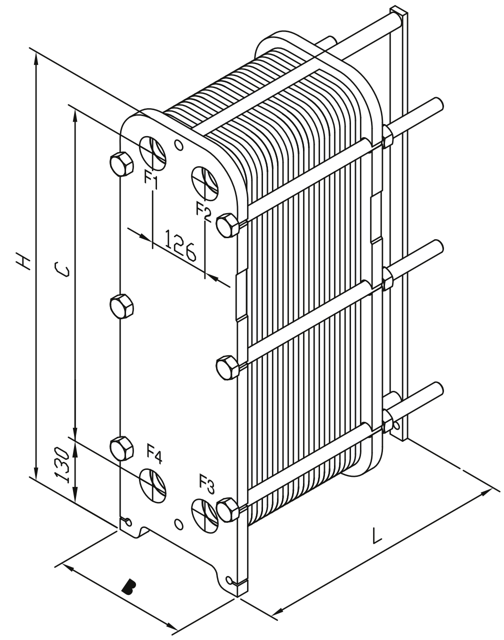


Fig. 4.3: WTE 40

Device information, stainless steel plate heat exchanger

Dimensions and weights	Unit	WTE 20		WTE 30		WTE 37		WTE 40	
Number of plates		34		43		50		28	
Actual surface	m²	2.69		3.44		4.03		3.90	
Volume	dm³	7		9		11		9	
Height [H]	mm	748		748		748		896	
Width [B]	mm	200		200		200		283	
Depth [L]	mm	270		320		420		437	
Net weight	kg	67		71		76		132	
Gross weight	kg	74		80		87		143	
Accessories		SZB 250		SZB 300		SZB 400		SZB 400	
		Secondary	**Primary**	**Secondary**	**Primary**	**Secondary**	**Primary**	**Secondary**	**Primary**
Quantity	m³ / h	4.5	5.8	7.0	8.0	8.5	9.3	11.0	11.0
Inlet temperature	°C	5.00	10.00	5.00	10.00	5.00	10.00	5.00	10.00
Outlet temperature	°C	8.41	7.00	8.07	7.00	7.92	7.00	7.58	7.00
Pressure drop	Pa	23,740	30,220	32,110	37,750	36,630	37,720	37,610	32,960
Transferred output	kW	18		25		29		33	
Inlet stubs		F1	F3	F1	F3	F1	F3	F1	F3
Outlet stubs		F4	F2	F4	F2	F4	F2	F4	F2
Secondary connections		DN 32 (1 ¼" external thread)						DN 50 (2" external thread)	
Primary connections		DN 32 (1 ¼" external thread)						DN 50 (2" external thread)	
Plate material		0.5 mm AISI 316						0.4 mm AISI 316	
Sealing material		NITRIL HT HANG ON (H) / 140							

4.3.3.2 Stainless steel plate heat exchangers WTE 50 to WTE 130

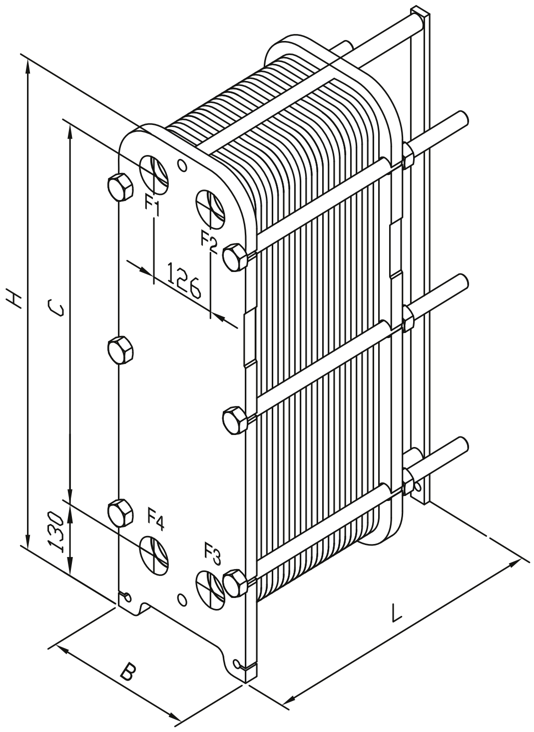


Fig. 4.4: WTE 50 – WTE 100

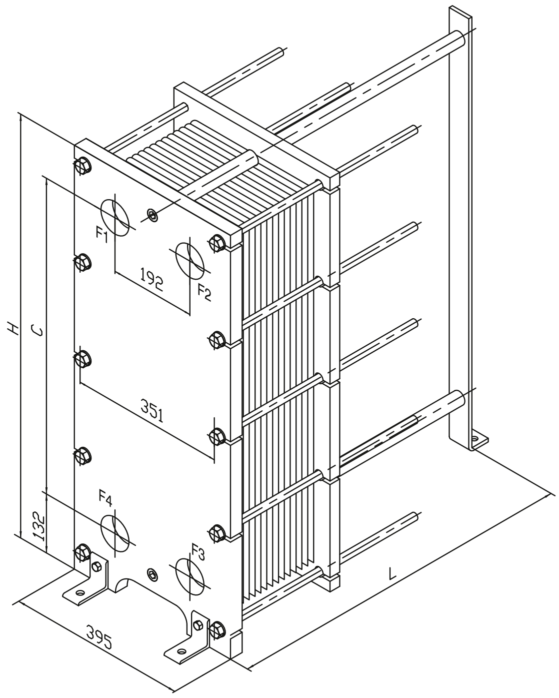


Fig. 4.5: WTE 130

Device information, stainless steel plate heat exchanger

Dimensions and weights	Unit	WTE 50		WTE 75		WTE 100		WTE 130	
Number of plates		33		51		62		52	
Actual surface	m²	4.65		7.35		9.00		11.14	
Volume	dm³	11		17		21		31	
Height [H]	mm	896		896		896		946	
Width [B]	mm	283		283		283		395	
Depth [L]	mm	437		537		537		443	
Net weight	kg	136		150		160		253	
Gross weight	kg	147		167		171		284	
Accessories		SZB 500		SZB 750		SZB 100		SZB 1300	
		Secondary	**Primary**	**Secondary**	**Primary**	**Secondary**	**Primary**	**Secondary**	**Primary**
Quantity	m³ / h	12.8	12.8	20.4	20.4	24.0	24.8	33.8	33.8
Inlet temperature	°C	5.00	10.00	5.00	10.00	5.00	10.00	5.00	10.00
Outlet temperature	°C	7.67	7.00	7.64	7.00	7.75	7.00	7.65	7.00
Pressure drop	Pa	38,910	36,400	38,830	35,380	39,770	38,960	40,190	36,720
Transferred output	kW	40		63		77		105	
Inlet stubs		F1	F3	F1	F3	F1	F3	F1	F3
Outlet stubs		F4	F2	F4	F2	F4	F2	F4	F2
Secondary connections		DN 50 (2" external thread)						DN 65 (flange)	
Primary connections		DN 50 (2" external thread)						DN 65 (flange)	
Plate material		0.4 mm AISI 316							
Sealing material		NITRIL HT HANG ON (H) / 140							

4.3.3.3 Titanium plate heat exchangers WTT 40 to WTT 100

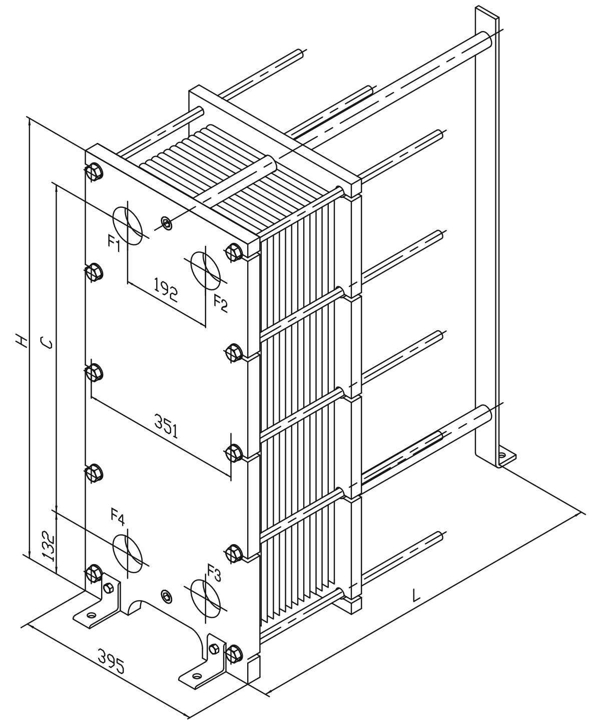


Fig. 4.6: WTT 40 – WTT 100

Device information, titanium plate heat exchanger

Dimensions and weights	Unit	WTT 40		WTT 50		WTT 75		WTT 100	
Number of plates		15		17		23		28	
Actual surface	m²	2.90		3.34		4.68		5.79	
Volume	dm³	8		10		13		16	
Height [H]	mm	946		946		946		946	
Width	mm	395		395		395		395	
Depth [L]	mm	443		443		443		443	
Net weight	kg	223		227		234		240	
Gross weight	kg	223		227		234		240	
Accessories		SZB 400		SZB 500		SZB 750		SZB 100	
		Secondary	**Primary**	**Secondary**	**Primary**	**Secondary**	**Primary**	**Secondary**	**Primary**
Quantity	m³ / h	9.7	11.0	11.4	12.8	18.0	20.3	22.0	24.8
Inlet temperature	°C	4.00	10.00	4.00	10.00	4.00	10.00	4.00	10.00
Outlet temperature	°C	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Pressure drop	Pa	27,280	31,490	28,870	33,320	33,680	38,820	33,550	38,680
Transferred output	kW	34		40		63		77	
Inlet stubs		F1	F3	F1	F3	F1	F3	F1	F3
Outlet stubs		F4	F2	F4	F2	F4	F2	F4	F2
Secondary connections		DN 65 (flange)							
Primary connections		DN 65 (flange)							
Plate material		0.5 mm TITANIUM							
Sealing material		NITRIL HT HANG ON (H) / 140							

5 Noise emissions from heat pumps

Every noise source - a heat pump, a car or an airplane - emits a certain amount of sound. Thus, the air surrounding the source of noise is turned into vibrations and the pressure spreads out in waves. On reaching human ears, this pressure wave creates vibrations in the eardrum, which triggers the hearing process.
Sound field parameters are used to describe this so-called airborne sound. The sound pressure and sound power are two of these parameters.
The sound power is a theoretical dimension typical for a sound source. It can be mathematically calculated from measurements. The sound power is the total acoustic energy emission in all directions.
The sound pressure is the change in air pressure as a result of vibrations in the air caused by the noise source. The greater the change in the air pressure, the louder the noise will be perceived.

Physically speaking, sound is caused by the propagation of pressure and density fluctuations in a gas, liquid or solid. Generally, sound is absorbed (i.e. heard) by human beings in the form of airborne sound as a noise, a tone or a bang. Pressure changes in the range between $2*10^{-5}$ Pa to 20 Pa can be detected by human hearing. These pressure changes correspond to vibrations with frequencies between 20 Hz and 20 kHz and represent the human audible sound or the range of audibility. The frequencies result in individual tones. Frequencies that are above of the range of audibility are referred to as ultrasonic sound, those below as infrasonic sound.

The sound transmissions from noise or other sources of sound are given or measured in decibels (dB). This is referred to here as a reference value, in which the value 0 dB generally represents the auditory threshold. A doubling of the sound level, i.e. by a second source of sound with equal sound transmission, corresponds to an increase of +3 dB. For the average human sense of hearing, an increase of +10 dB is necessary so that a noise is perceived as twice as loud.

There are two types of sound propagation.

Solid-borne noise

Mechanical vibrations are started in bodies such as machines and building sections, transmitted within these bodies and partially emitted as airborne sound at a different point.

Airborne Sound

Sound sources (bodies triggered into creating vibration) create mechanical vibrations in the air, which spread like waves and are detected by the human ear.

5.1 Sound pressure level and sound power level

The terms "sound pressure level" and "sound power level" are frequently confused and compared with each other. In acoustics, sound pressure refers to the measurable level that is triggered by a sound source at a certain distance. The closer the sound source, the higher the measured sound pressure level and vice versa. Thus, the sound pressure level is a measurable dimension, dependent upon distance and direction; it is, for example a decisive factor for adherence to the immission standards according to the German government's TA-Lärm-Technical Instructions for Noise.

The total air pressure given off in all directions by a sound source, is denoted as sound power or as sound power level. Increasing distance from the sound source causes the sound power to spread out upon an ever-increasing surface. The value will remain unchanged as long as the total emitted sound power is taken into consideration with reference to the enveloping surface at a specified distance. Because the sound power emitted in all directions cannot be precisely calculated metrologically, the sound power must be determined from a measured sound pressure at a specified distance. Thus, the sound power level is specific to the source of sound, independent of distance and direction, and can only be only be determined via mathematical calculation. Based on the emitted sound power level, sound sources can be compared with each other.

5.1.1 Emission and immission

The total sound emitted from a sound source (sound event) is referred to as acoustic emission. Sound source emissions are generally denoted as sound power level. The effect of sound upon a specified location is referred to as acoustic immission. Acoustic immissions can be measured as the sound pressure level. Fig. 5.1 on page 57 graphically depicts the interrelationship between emissions and immissions.

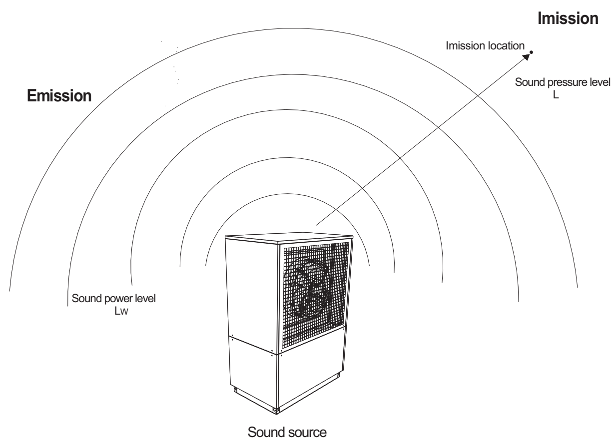


Fig. 5.1: Emission and immission

Noise immissions are measured in dB(A), meaning sound level values in relation to the sensitivity of the human sense of hearing. Noise refers to the sound that disturbs neighbours or third parties, and is extremely disadvantageous or potentially hazardous to these. Guideline values for noise at immission sites outside of buildings are stipulated in the DIN 18005 "Sound Protection in City Buildings" or in the "German government's Technical Instructions for Noise" (TA). The requirements in accordance with the "German government's Technical Instructions for Noise" (TA) are listed in *Table 5.1 on page 57*.

Regional categories	Day	Night
Hospitals and health spa facilities	45	35
Schools, nursing homes	45	35
Allotments, parks	55	55
Residential areas WR	50	35
General residential areas WA	55	40
Housing estates WS	55	40
Special residential areas WB	60	40
Central areas MK	65	50
Village areas MD	60	45
Mixed-use areas MI	60	45
Trading estates GE	65	50
Industrial areas GI	70	70

Table 5.1: Limit values for noise immissions in dB(A) according to DIN 18005 and the German government's Technical Instructions on Noise

Sound source	Sound level [dB]	Sound pressure [μPa]	Perception
Absolute silence **Inaudible**	0 10	20 63	Inaudible
Ticking of a pocket watch, quiet bedroom	20	200	Very quiet
Very quiet garden, air conditioning in a theatre	30	630	Very quiet
Residential area without traffic, air conditioning in offices	40	2 * 10	Quiet
Slow-moving brook or river, quiet restaurant	50	6.3 * 10	Quiet
Normal conversation, car	60	$2 * 10^4$	Loud
Loud office, loud speech, motorcycle	70	$6.3 * 10^4$	Loud
Heavy traffic noise, loud radio music	80	$2 * 10^5$	Very loud
Heavy goods vehicle	90	$6.3 * 10^5$	Very loud
Car horn at a distance of 5 m	100	$2 * 10^6$	Very loud
Pop group, foundry	110	$6.3 * 10^6$	Unbearable
Tunnel boring machine at a distance of 5 m	120	$2 * 10^7$	Unbearable
Jet taking off at a distance of 100 m	130	$6.3 * 10^7$	Unbearable
Jet engine at a distance of 25 m	140	$2 * 10^8$	Painful

Table 5.2: Typical sound levels

5.1.2 Sound propagation

As already described, the sound power spreads out upon an increasing surface with increasing distance, so that the resulting sound pressure level decreases at an ever-increasing distance. Additionally, the sound pressure value depends upon a specified point of the sound propagation.

The following characteristics of the environment influence the sound propagation:

- Shading due to major obstacles, such as buildings, walls or land formations
- Reflections on reverberant surfaces such as rendering and glass facades of buildings, or the asphalt and stone surfaces of floors.
- Reduction of the level propagation by sound-absorbing surfaces, such as fresh snow, bark mulch or similar.
- Increase or reduction due to air humidity and air temperature or wind direction

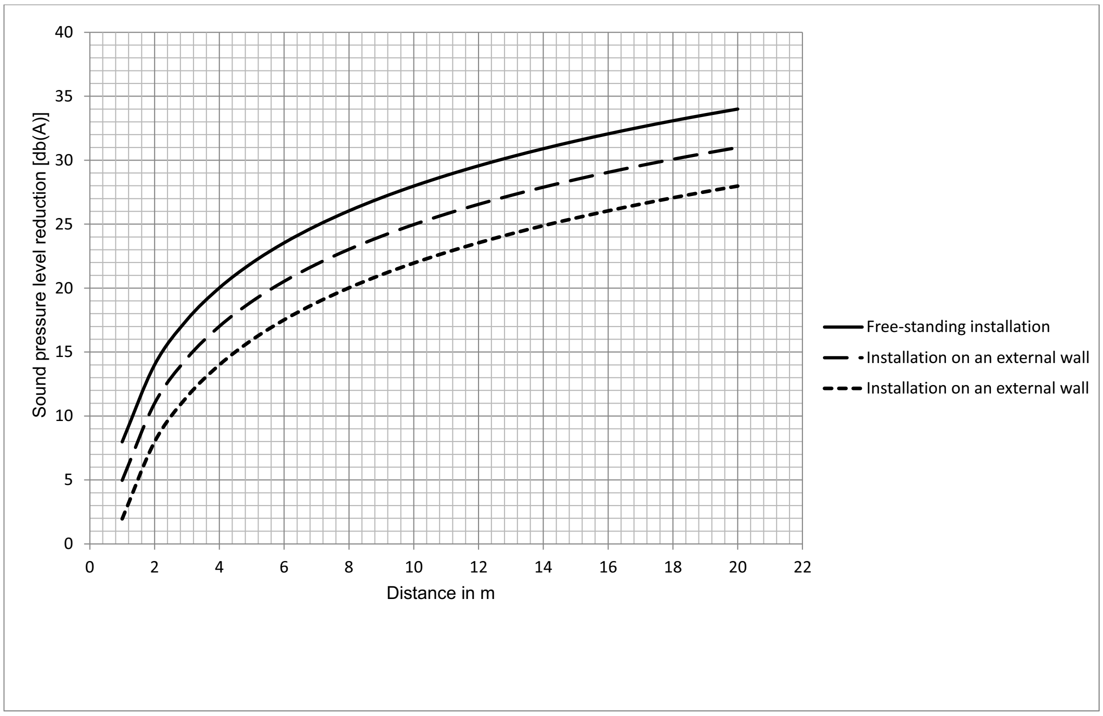


Fig. 5.2: Sound pressure level reduction with different installation

There are three different versions of heat pump installation:

- Free-standing heat pump installation (Q=2)
- Heat pump or air inlet/outlet (for indoor installation) on a building wall (Q=4)
- Heat pump or air inlet/outlet (for indoor installation) on a building wall with edge pointing inwards (Q=8)

For each of these installation versions, there is a different sound pressure level inspection the further away you get from the heat pump.

Example:

Sound power level LA 9TU: 60 dB(A)

Fig. 6.2 shows the sound pressure level inspection for the three different installation version with a LA 9TU.

i NOTE

Directional sound pressure levels are significant for heat pumps installed outdoors.

For air-to-water heat pumps installed outdoors, there are four main directions of sound propagation. The air intake side is indicated by "1" and the air outlet side by "3".

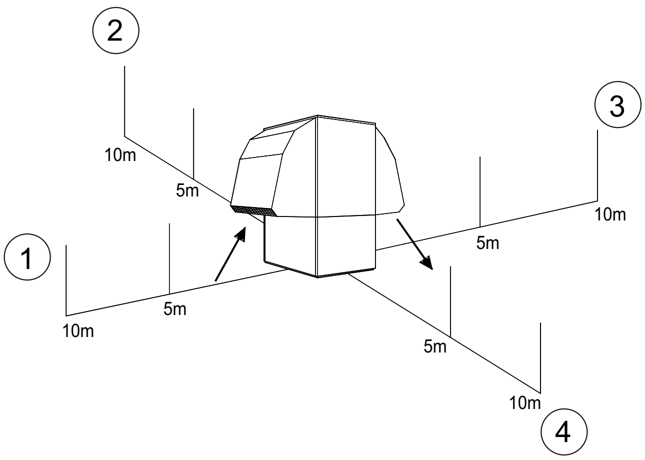


Fig. 5.3: Sound directions for air-to-water heat pumps installed outdoors.

5.2 Sound propagation of heat pumps

Different measures for sound protection should be implemented when installing heat pumps depending on the installation location.

Indoor installation

Like any boiler, heat pumps should be connected with isolating fixings. The heat pump should be connected to the heating flow and return with pressure-resistant, temperature-resistant, non-ageing, flexible hoses to prevent vibrations being transmitted. Most heat pumps are also equipped with a vibration-isolated compressor base plate, which means that the compressor is installed on a separate base plate positioned on on rubber buffers for solid-borne noise insulation. For reducing the transmission of solid-borne noise, the heat pump should be set up on SYL 250 sylomer strips (available as accessory).

Outdoor installation

Solid-borne noise insulation is only necessary if the heat pump's foundation is in direct contact with the building. Flexible hoses facilitate the connection of the heat pump to the heating system and simultaneously prevent any vibrations from being transmitted.

Most heat pumps for outdoor installation also have a vibration-isolated compressor base plate. Sound propagation must also be taken into account when installing heat pumps outdoors. Blowing out air directly onto terraces, balconies etc. should be avoided. Blowing air directly on to building walls should also be avoided, as this can increase the sound pressure level. Structural obstacles can reduce the sound propagation. The outlet side should be directed towards the street where possible.

i NOTE

The air flow of air-to-water heat pumps installed outdoors must not be obstructed at any side.

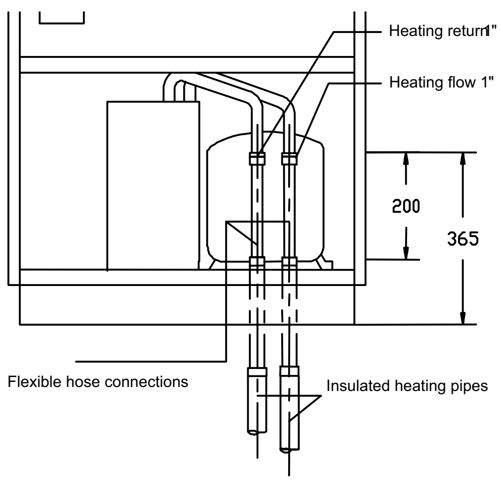


Fig. 5.4: Example of how a heat pump is integrated when installed outdoors

Vibration isolation with expansion joints

Double-sphere rubber expansion joint for isolating heat pumps and heating systems. The expansion joints absorb vibrations and movements caused by pumps, compressors, fittings and other sources, reduce noise output and even out internal strain (axial and lateral deviations) stemming from imprecisions in assembly.

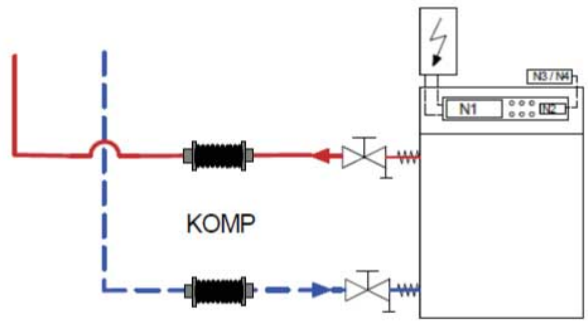


Fig. 5.5: Integration of expansion joints

In order to guarantee the functionality of the expansion joints and not shorten their working lives due to any additional stress, a number of rules should be observed:

- Expansion joints must be installed in such a way that their position and movement are not impeded.
- During assembly and after installation, care should be taken not to displace the bellows or subject them to any form of torsional strain.
- The bellows should be protected against any damage arising from external mechanical, thermal or chemical influences.
- The bellows convolutions must be completely free from any contamination.

Acoustic emission of air-to-water heat pumps installed outdoors

Fig. 5.3 on page 58 shows the four main directions of sound propagation. The air inlet side is indicated by direction "1" and the air outlet side by direction "3".

Directional sound pressure levels of the air-to-water heat pumps can be determined using the tables . The values at a distance of 1 m are actual measured values. The values at a distance of 5 and 10 m are calculated on the basis of hemispherical propagation in the open air. Deviations are possible in actual use on account of sound reflection and/or sound absorption due to local conditions.

Type	LA 20AS / LA 17PS				LA 24AS / LA 28AS			
Dir.	1	2	3	4	1	2	3	4
1m	52	48	54	48	56	50	58	50
5m	41	37	43	37	45	39	47	39
10m	35	31	37	31	39	33	41	33

Table 5.3: Sound propagation LA 20-24AS and LA 17PS

Type	LA 22PS / LA 26PS LA 26HS			
Dir.	1	2	3	4
1m	56	50	58	50
5m	45	39	47	39
10m	39	33	41	33

Table 5.4: Sound propagation LA 22-26PS and LA 26HS

Type	LA 11TAS			
Dir.	1	2	3	4
1m	47	44	48	44
5m	35	33	36	33
10m	30	27	31	27

Table 5.5: Sound propagation LA 11TAS

Type	LA 16TAS			
Dir.	1	2	3	4
1m	48	46	49	46
5m	37	35	38	34
10m	31	29	32	29

Table 5.6: Sound propagation LA 16TAS

Type	LA 6TU			
Direction	1	2	3	4
1m	43	42	46	42
5m	31	30	34	30
10m	26	25	29	25

Table 5.7: Sound propagation LA 6TU

Type	LA 9TU			
Direction	1	2	3	4
1m	46	43	48	43
5m	35	31	36	31
10m	29	26	30	26

Table 5.8: Sound propagation LA 9TU

Type	LA 12TU			
Direction	1	2	3	4
1m	48	46	48	46
5m	37	35	37	35
10m	31	29	32	30

Table 5.9: Sound propagation LA 12TU

Type	LA 17TU			
Direction	1	2	3	4
1m	50	47	52	46
5m	40	37	42	36
10m	34	31	37	30

Table 5.10: Sound propagation LA 17TU

Type	LA 25TU			
Direction	1	2	3	4
1m	52	46	55	47
5m	42	35	45	36
10m	36	30	40	31

Table 5.11: Sound propagation LA 25TU

Type	LA 40TU			
Direction	1	2	3	4
1m	56	50	60	49
5m	45	39	49	38
10m	39	33	43	32

Table 5.12: Sound propagation LA 40TU

Type	LA 60TU			
Direction	1	2	3	4
1m	64	61	66	60
5m	54	51	56	50
10m	49	45	50	45

Table 5.13: Sound propagation LA 60TU

Type	LA 8PMS			
Direction	1	2	3	4
1m	49	48	50	48
5m	37	36	38	36
10m	31	30	32	31

Table 5.14: Sound propagation LA 8PMS

Type	LA 14PMS			
Direction	1	2	3	4
1m	49	47	52	47
5m	38	36	41	36
10m	33	31	35	31

Table 5.15: Sound propagation LA 14PMS

Type	LA 11MAS			
Direction	1	2	3	4
1m	49	49	51	48
5m	37	37	39	36
10m	32	31	33	31

Table 5.16: Sound propagation LA 11MAS

Type	LA 16MAS			
Direction	1	2	3	4
1m	50	49	51	49
5m	39	37	40	37
10m	33	32	34	32

Table 5.17: Sound propagation LA 16MAS

6 Domestic hot water preparation with heat pumps

6.1 Heating domestic hot water with the heat pumps for heating purposes

The heat pump manager regulates both space heating as well as the preparation of domestic hot water (see chapter on regulation). The system for heating domestic hot water using the heat pump should be set up parallel to the system for space heating, because a different domestic hot water temperature is normally required for domestic hot water preparation than for space heating. The return sensor should be installed in the common return of the heating system and the domestic hot water heating system (see chapter on integration).

6.1.1 Requirements placed on the domestic hot water cylinder

The standard continuous power ratings specified by the different cylinder manufacturers are not suitable criteria for selecting a cylinder for heat pump operation. The following criteria must be taken into consideration when selecting a cylinder: the size of the heat exchanger area, the construction and the layout of the heat exchanger in the cylinder, the continuous power rating, the flow rate and the installation position of the thermostat or sensor.

The following criteria must be taken into consideration:

- Heating up stationary domestic hot water (covering water level losses - static state).
- The heat output of the heat pump at the maximum heat source temperature (e.g. air +35 °C) must also be transferable at a cylinder temperature of +45 °C.
- The cylinder temperature is lowered when a circulation pipe is used. The circulation pump should be time-controlled.
- It must be possible to tap the required amount of domestic hot water even during shut-off times without the heat pump having to reheat.
- Selective reheating using a flange heater is only possible in combination with a temperature sensor.

⚠ ATTENTION!

On systems where the domestic hot water preparation takes place via the glycol circuit, the glycol can be prevented from coming into contact with drinking water using suitable measures. These measures include using food-safe glycol (e.g. propylene glycol) or using double-walled safety heat exchangers.

6.1.2 Domestic hot water cylinder for heat pumps for heating purposes

Domestic hot water cylinders are used to heat the water for sanitary facilities. The heating takes place indirectly via an installed pipe coil with heating water or combo tanks directly into the finned tube heat exchangers according to the flow principle.

Design

The tanks are manufactured in a cylindrical design according to DIN 4753 Part 1. The heating surface consists of a welded, coil-shaped bent pipe or a finned tube heat exchanger with direct domestic hot water preparation. All connections lead out from one side of the cylinder.

Corrosion protection

According to DIN 4753 Part 3, the entire interior surface of the cylinders is protected by an approved enamel coating. This enamelling is applied in a special process, and guarantees reliable corrosion protection in combination with the magnesium anode which is fitted as an accessory.

According to the specifications of the German Technical and Scientific Association for Gas and Water (DVGW), the magnesium anode should be initially inspected by after-sales service after 2 years of use and then at regular intervals. It should be replaced according to need. Depending on the quality of the domestic water (conductivity), it is advisable to have the reactive anode inspected in shorter intervals.

The anode (33 mm) should be replaced once it has reduced in size to a diameter of 10-15 mm.

The stray current anode (Correx anode) is also available as an alternative to the magnesium anode. It is connected directly to a voltage source and is therefore maintenance-free.

Water hardness

Domestic water contains varying amounts of lime depending on its source. Hard water contains a large amount of lime. There are different water hardness levels which, in Germany, are measured in degrees of hardness (°dH).

Hardness level soft	=	less that 1.5 millimoles of calcium carbonate per litre (equivalent to 8.4 °dH)
Hardness level medium	=	From 1.5 to 2.5 millimoles of calcium carbonate per litre (equivalent to 8.4 to 14 °dH)
Hardness level hard	=	more than 2.5 millimol calcium carbonate per litre (equivalent to more than 14 °dH)

“French degrees of hardness” are used in Switzerland. These correspond to

1° d.H. = 1.79° fr.H.

1° fr.H. = 0.56° d.H.

If electric flange heaters are used for general reheating to temperatures over 50 °C, we recommend the installation of a descaling system for water if the water supply has hardness level III with a hardness of > 14 °d.H. (hard and very hard water) or more.

Commissioning

Ensure that the water supply is turned on and the cylinder is filled before commissioning. The initial filling and commissioning must be carried out by an authorised specialist company. The entire system, including all factory-assembled components (e.g. flange lid) should be inspected to ensure that everything is working properly and that there is no leakage.

Cleaning and maintenance

The mandatory cleaning intervals vary according to the water quality and the temperatures of the heating medium and the cylinder. We recommended having the tank cleaned and the system checked once a year. The glass-like surface prevents extensive build-up of lime scale and enables rapid cleaning using a powerful water jet. Large pieces of lime scale may only be broken up using a piece of wood before being rinsed away. Sharp-edged metal objects must on no account be used for cleaning.

The operational reliability of the safety valve must be checked at regular intervals. We recommend having an annual service inspection carried out by a qualified specialist company.

Thermal insulation and covering

For cylinders with up to 500 litres nominal capacity, the thermal insulation is made up of high-quality PU (polyurethane) rigid foam, which is applied directly on the cylinder walls.

For cylinders larger than 500 litres, the thermal insulation is removable and consists of PE (polyethylene) or PS (polystyrene) foam with foil cladding for minimal stand-by losses.

Controller

The cylinders are equipped as standard with a sensor with an approx. 5 m long connecting lead, which is connected directly to the heat pump manager. The characteristic curve of the sensor complies with DIN 44574. The heat pump manager regulates the temperature settings and the time-controlled charging and reheating with the flange heater. Attention should be paid to the hysteresis when setting the domestic hot water temperature. It should also be noted that the measured temperature will rise slightly because the thermal processes in the cylinder still require some time to equalize after the domestic water has been heated.

Regulation can also be carried out using a thermostat. The hysteresis should not exceed 2 K.

Operating conditions:

Permissible operating overpressure	
Heating water	max. 3 bar
Domestic water	10 bar

Permissible operating temperature	
Heating water	110 °C
Domestic water	95 °C

Table 6.1: Permissible operating conditions

Installation

Assembly is limited to connecting the hydraulic components of the system along with its respective safety devices and to connecting the sensor.

Accessories

Flange heaters with bleeder resistor, designed for enamelled domestic hot water cylinders for thermal disinfection!

Electrical installations should only be connected by authorised electricians according to the corresponding circuit diagram. The relevant regulations according to the Technical Specifications for Electrical Installations (TAB) and the guidelines of the Association of German Engineers (VDI) should be observed.

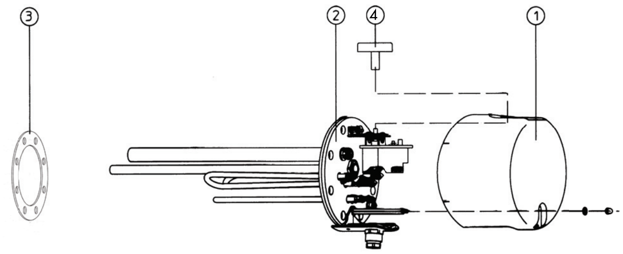


Fig. 6.1: Structure of a flange heater

1	Protective cap
2	Heating flange
3	Seal
4	Electrical connection

Table 6.2: Legend flange heater

Installation location

The cylinder should only be installed in a room protected from frost. Installation and commissioning must be carried out by an authorised specialist.

Water pipe connections

The cold water pipes are connected according to DIN 1988 and DIN 4573 Part 1 (see Fig. 6.2 on page 63). All connecting pipes should be joined using pipe unions.

A circulation pipe should only be connected if the domestic water supply system is extensive because it causes high stand-by losses. If a circulation system is required, it should be fitted with an automatic device to interrupt the circulation.

All connecting pipes including fittings (with the exception of the cold water connection) must be protected against heat losses according to the German Federal Energy Efficiency Ordinance (EnEV). Poorly insulated or uninsulated connecting pipes will lead to a loss of energy which is many times greater than the energy loss of the cylinder.

A check valve should always be fitted to the heating water connection to prevent the cylinder from heating up or cooling down uncontrollably.

The air outlet pipe of the safety valve connected to the cold water pipe must always remain unblocked. The operational readiness of the safety valve should be checked at regular intervals by venting it.

Drainage

A means of draining the cylinder should be provided in the cold water connecting pipe during construction.

Pressure reducing valve

It is essential to equip the connecting pipe with a pressure reducing valve if the max. supply pressure could exceed the permissible operating overpressure of 10 bar. However, according to DIN 4709, the pipe pressure should be lowered inside buildings to a level which still permits technical operability to reduce the generation of noise. Depending on the type of building, it may then be worthwhile to install a pressure reducing valve in the cylinder inlet.

Safety valve

A tested and non-closing safety valve should be installed where the cylinder is connected to the system. No constrictions, e.g. dirt traps, should be installed between the cylinder and the safety valve.

Water should be able to flow (drip) out of the safety valve when the cylinder is being heated up to compensate for the expansion of the water and to prevent a severe build-up in pressure. The safety valve overflow pipe must flow freely into a sewage system without any constrictions. The safety valve should be mounted in an easily accessible and observable location so that it can be vented during operation of the system. A sign should be fixed on the valve itself or in its vicinity with the following inscription: "Water may be discharged from the air outlet pipe during heating! Do not close!."

Use only spring-loaded diaphragm safety valves that have been tested.

The air outlet pipe should have at least the same cross section as the safety valve outlet. If it is necessary for the air outlet circuit to have more than two bends or if it is more than 2 m in length, an air outlet pipe in the next largest nominal size should be selected.

It is not permissible for the air outlet circuit to have more than three bends or to be more than 4 m in length. The cross section of the outlet pipe located downstream from the collecting hopper must be at least twice the size of the cross section of the valve inlet. The safety valve must be adjusted so that the permissible operating overpressure of 10 bar is not exceeded.

Check valve, test valve

A check valve (return inhibitor) must be installed to prevent the heated water from flowing back into the cold water pipe. Its function can be tested by closing the first isolating valve in the direction of flow and opening the test valve. Only the water contained in the short piece of pipe should be discharged.

Isolating valves

As illustrated in Fig. 6.2 on page 63, isolating valves are to be installed on the cylinder in both the cold and domestic hot water pipes as well as in the heating water flow and return.

Legend

1) Isolating valve
2) Pressure reducing valve
3) Test valve
4) Return inhibitor
5) Pressure gauge connecting stubs
6) Drain valve
7) Safety valve
8) Circulation pump
9) Outlet

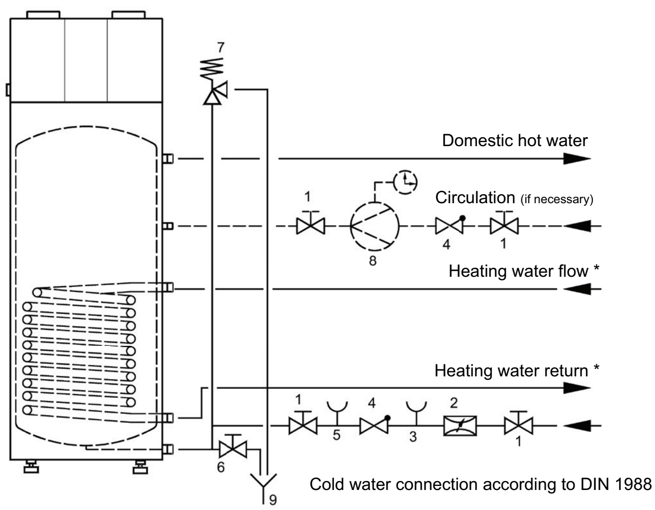


Fig. 6.2: Water pipe connections

Pressure drops

The pressure drops of the internal heat exchanger should be taken into consideration when dimensioning the charge pump for the domestic hot water cylinder.

Temperature settings for domestic hot water preparation with the heat pump for heating purposes

Low-temperature heat pumps have a max. flow temperature of 55 °C. This temperature must not be exceeded during the preparation of domestic hot water in order to prevent the heat pump from being switched off by the high pressure switch. The temperature setting of the controller should, therefore, be below the maximum attainable cylinder temperature.

The maximum attainable cylinder temperature is dependent on the output of the installed heat pump and the amount of heating water flowing through the heat exchanger. The maximum attainable domestic hot water temperature for heat pumps for heating purposes is calculated according to Chapt. 6.1.3 on page 64. It should also be taken into consideration that the thermal energy stored in the heat exchanger will cause a further reheating of approx. 3 K. The set temperature can be 2 to 3 K lower than the desired domestic hot water temperature when preparing domestic hot water with the heat pump.

6.1.3 Attainable domestic hot water cylinder temperatures

The maximum domestic hot water temperature which can be attained using a heat pump is dependent on:

- The heat output of the heat pump
- The heat exchanger surface area installed in the cylinder and
- The discharge rate (volume flow) of the circulating pump.

The domestic hot water cylinder must be selected on the basis of the max. heat output of the heat pump (summer operation) and the desired cylinder temperature (e.g. 45 °C).

The pressure drops of the cylinder should be taken into consideration when designing the domestic hot water circulating pump.

The heat supplied by the heat pump cannot be transferred if the maximum domestic hot water temperature (HP maximum) to be attained using a heat pump is set too high on the controller (also see the chapter Control and Regulation).

When the maximum permissible pressure in the refrigerating circuit is reached, the heat pump manager's high pressure safety program switches off the heat pump automatically, blocking domestic hot water heating for 2 hours.

If the domestic hot water cylinder is equipped with a sensor, the set domestic hot water temperature (HP maximum new = current actual temperature in the domestic hot water cylinder – 1 K) is corrected automatically.

If higher domestic hot water temperatures are required, the water can be reheated electrically according to need (flange heater in the domestic hot water cylinder).

NOTE

The domestic hot water temperature (HP maximum) should be set approx. 10 K below the maximum flow temperature of the heat pump.
In mono energy heat pump systems the domestic hot water preparation takes place exclusively via the flange heating as soon as the heat pump cannot cover the heat consumption of the building on its own.

Example:

Heat pump with a maximum heat output of 14 kW with a maximum flow temperature of 55 °C

Domestic hot water cylinder - 400 l tank

Volume flow of the domestic hot water circulating pump: 2,0 m^3/h

This yields a
domestic hot water temperature of: ~47 °C

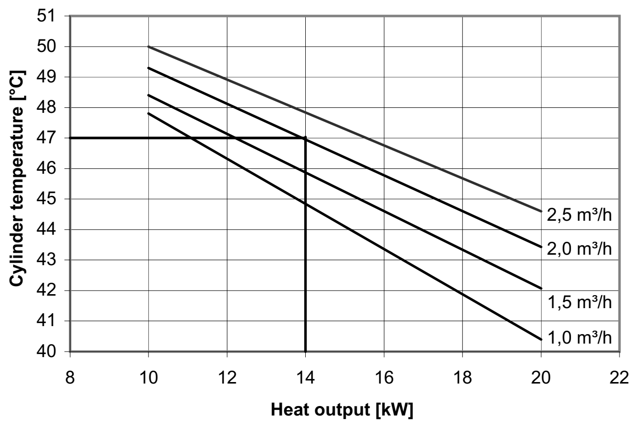


Fig. 6.3: Design of a domestic hot water cylinder using WWSP 800 as an example

6.1.4 Design support for combination and domestic hot water cylinders

The table shows the allocation of domestic hot water circulating pumps and cylinders to the individual heat pumps with which a domestic hot water temperature of approx. 45 °C is reached in operation with 1 compressor (maximum temperatures of the heat sources: Air: 25 °C, Brine 10 °C, water: 10 °C, maximum pipe length between heat pump and cylinder: 10 m). The maximum domestic hot water temperature which can be attained with heat-pump-only operation is dependent on:

- The heat output of the heat pump
- The heat exchanger surface area in the cylinder
- The volume flow in relation to the pressure drop and the capacity of the circulating pump.

NOTE

Higher temperatures can be reached by implementing larger heat exchanger areas in the cylinder, by increasing the volume flow or by targeted reheating using a heating element (see also Chapt. 6.1.3 on page 64).

NOTE

The design takes place based on the integration set-ups recommended in this manual and standard boundary conditions.

NOTE

In accordance with Article 3, Para. 3 of the European Pressure Equipment Directive, buffer and domestic hot water cylinders may not carry a CE label. The directive stipulates that "pressure equipment and/or assemblies... must be designed and manufactured in accordance with the good engineering practice valid in a member state to guarantee that they can be used safely."

Air-to-water heat pumps (indoor installation)				
Heat pump	**Volume in litres**	**Heat exchange surface in m²**	**Cylinder**	**Charge pump M18**
LIK 8TES / LI 9TES / LI 11TES / LI 20TE	300	3.2	WWSP 332 / PWS 332	UP 60
LI 9TU / LI 12TU	300	3.2	WWSP 332	UP 60
LIKI 14TE / LI 24TE	400	4.2	WWSP 880	UP 60
LI 16TES / LI 28TE	400	4.2	WWSP 880	UP 80
LI 15TE	400	4.2	WWSP 880	UP 80
LIH 26TE	500	5.7	WWSP 900	UP 80
LI 40AS	500	5.7	WWSP 900	UP 80 / UP 70-32
	800	8	WWSP 885S	

Air-to-water heat pumps 230V (indoor installation)				
Heat pump	**Volume in litres**	**Heat exchange surface in m²**	**Cylinder**	**Charge pump M18**
LI 11ME	300	3.2	WWSP 332 / PWS 332	UP 60

Air-to-water heat pumps (outdoor installation)				
Heat pump	**Volume in litres**	**Heat exchange surface in m²**	**Cylinder**	**Charge pump M18**
LIA 7IM - LIA 16IM	300	3.2	WWSP 332	Integrated
LA 6TU	300	3.2	PWS 332	UP 60
LA 9TU / LA 12TU / LA 17TU	300	3.2	WWSP 332 / PWS 332	UP 60
LA 11PS / LA 17PS	300	3.2	WWSP 332 / PWS 332	UP 60
LA 22PS	300	3.2	WWSP 332 / PWS 332	UP 80
LA 11TAS	300	3.2	WWSP 332 / PWS 332	
LA 16TAS	400	4.2	WWSP 880	
LA 25TU	400	4.2	WWSP 880	UP 60
LA 26PS	400	4.2	WWSP 880	UP 80
LA 26HS	500	5.7	WWSP 900	UP 80
LA 40TU	500	5.7	WWSP 900	UP 80 / UP 70-32
	800	8	WWSP 885S	
LA 60TU	800	8	WWSP 885S	6 m³/h

Brine-to-water heat pumps				
Heat pump	**Volume in litres**	**Heat exchange surface in m²**	**Cylinder**	**Charge pump M18**
SIK 7TE / SIK 9TE / SIK 11TE	300	3.2	WWSP 332 / PWS 332	UP 60
SIH 6TE / SIH 9TE / SIH 11TE	300	3.2	WWSP 332	UP 60
SI 6TU / SI 8TU / SI 11TU	300	3.2	WWSP 332	UP 60
SIK 7TE / SIK 9TE / SIK 11TE	400	4.2	WWSP 442E	UP 60
SIK 14TE	400	4.2	WWSP 442E	UP 80
SI 14TU	400	4.2	WWSP 880	UP 80
SI 18TU	400	4.2	WWSP 880	UP 80
SIH 20TE	400	4.2	WWSP 442E	UP 60-32
SI 24TE / SI 30TE	400	4.2	WWSP 442E	UP 70-32
SI 22TU	500	5.7	WWSP 900	UP 70-32
SIH 40TE / SI 37TE	500	5.7	WWSP 900	UP 70-32
SI 50TE	500	5.7	WWSP 900	UP 70-32
	800	8	WWSP 885S	
SI 75TE	800	8	WWSP 885S	6.5 m³/h
SI 100TE	2 x 500	11.4	2 x WWSP 900	8.5 m³/h
SI 130TE	3 x 500	17.1	3 x WWSP 900	11.5 m³/h
	2 x 800	16	2 x WWSP 885S	

Brine-to-water heat pumps 230V				
Heat pump	**Volume in litres**	**Heat exchange surface in m²**	**Cylinder**	**Charge pump M18**
SIK 11ME/ SI 5ME/ SI 9ME/ SI 11ME	300	3.2	WWSP 332	UP 60
SIK 11ME	400	4.2	WWSP 442E	UP 60
SIK 16ME	400	4.2	WWSP 442E	UP 80

Water-to-water heat pumps				
Heat pump	**Volume in litres**	**Heat exchange surface in m²**	**Cylinder**	**Charge pump M18**
WI 10TU	300	3.2	WWSP 332	UP 60
WI 14TU	300	3.2	WWSP 332	UP 60
WI 18TE	400	4.2	WWSP 880	UP 80
WI 22TE	500	5.7	WWSP 900	UP 70-32
WI 27TE	500	5.7	WWSP 900	UP 70-32
WI 50TU	500	5.7	WWSP 900	UP 70-32
	800	8	WWSP 885S	
WI 100TU	2 x 500	11.4	2 x WWSP 900	7.5 m³/h

Water-to-water heat pumps 230V				
Heat pump	**Volume in litres**	**Heat exchange surface in m²**	**Cylinder**	**Charge pump M18**
WI 9ME / WI 14ME	300	3.2	WWSP 332 / PWS 332	UP 60

Table 6.3: Design aid for combination and domestic hot water cylinders

6.1.5 Country-specific requirements Germany: German Technical and Scientific Association for Gas and Water (DVGW) - worksheet W 551

The DVGW worksheet W 551 describes measures for reducing the growth of legionella bacteria in domestic water systems. A distinction is made between **small systems** (detached and semi-detached houses) and **large systems** (all other systems with cylinder volumes larger than 400 litres and pipe volumes larger than 3 l between the cylinders and the extraction points).

For small systems, a standard temperature setting of 60 °C is recommended on the domestic hot water preparation equipment. Operating temperatures under 50 °C should always be avoided. When using low-temperature heat pumps, the reheating in the domestic hot water cylinder should take place via a supplementary electric heater for economic reasons.

The water at the domestic hot water outlet, for example, must be heated to a minimum of 60 °C for large systems. If the design of the heat pumps is correct, these temperatures can also be achieved with medium-temperature heat pumps. In bivalent systems, the domestic hot water preparation should be carried out by the second heat generator.

Pipe lengths with a 3 l volume	
Copper pipe ∅ x mm	**Pipe length / m**
10 x 1.0	60.0
12 x 1.0	38.0
15 x 1.0	22.5
18 x 1.0	14.9
22 x 1.0	9.5
28 x 1.0	5.7
28 x 1.5	6.1

Switzerland: SVGW data sheet TPW: Legionella in domestic water installations – What has to be taken into account?

This data sheet discusses where problems with legionella bacteria in domestic water could arise and the available options for effectively reducing the risk of infection.

i NOTE

Installation of a flange heater is generally recommended to enable heating to temperatures of over 60 °C. Electric reheating can be time-controlled by the controller according to the application and/or customer requirements.

6.1.6 Hydraulic connection of domestic hot water cylinders

Connecting the combination cylinder PWD 750

The following drawing shows the domestic hot water preparation via a combination cylinder PWD 750 with circulation line. In normal tapping operation, a part of the domestic water is fed over the heat exchanger of the PWD 750 and heated up. The domestic hot water set temperature is regulated via the built-in thermostat-controlled three-way valve. When the circulation pump is activated, part of the water is fed into the top right heat exchanger via the bypass and heated up there. The thermostat-controlled three-way valve then mixes the heated water into the circulation pipe until the desired temperature is reached.

i NOTE

In contrast to the PWD 750, the heat exchangers are arranged in a line one above the other in the combination cylinders PWD 900 and PWD 1250. This must be taken into account in the hydraulic integration of the cylinders.

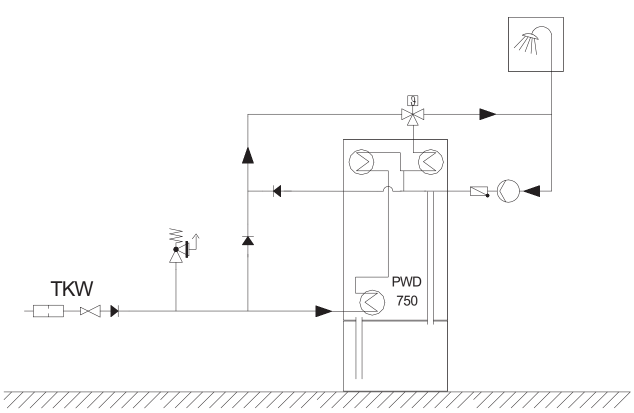


Fig. 6.4: Integration of the circulation return in the cold water inlet of the thermostat mixer

Combination of multiple domestic hot water cylinders

If water consumption is very high or if heat pumps with an output of more than approx. 28 kW are implemented for domestic hot water operation, the heat exchanger area required to ensure that adequate domestic hot water temperatures are maintained can be created by connecting the heat exchangers of several domestic hot water cylinders in parallel or in series. (Refer to German Technical and Scientific Association for Gas and Water - work sheet W551)

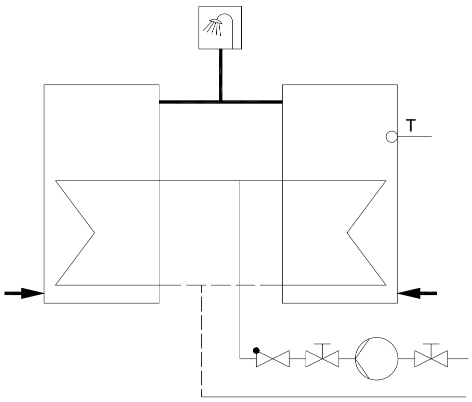


Fig. 6.5: Connecting domestic hot water cylinders in parallel

Connecting more than one domestic hot water cylinder in parallel is particularly suitable where large quantities of water are tapped. This is only possible when identically constructed domestic hot water cylinders are used. When connecting the heat exchangers with the domestic hot water circuit, the pipes from the tee joint onwards leading to each cylinder should have the same pipe diameter and the same length. This ensures that the heating water volume flow is divided between the two systems with the same drop in pressure. (see Fig. 6.5 on page 67)

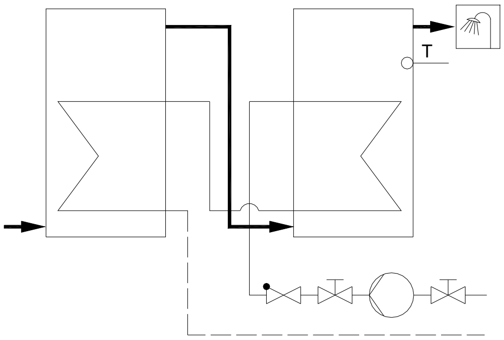


Fig. 6.6: Connecting domestic hot water cylinders in series

It should be taken into consideration during series integration of domestic hot water cylinders that the heating water must first pass through the cylinder from which the domestic hot water is drawn. (see Fig. 6.6 on page 67)

6.2 Air-to-water heat pump module LI 2M for utilisation of waste heat

6.2.1 Intended purpose

The heat pump module LI 2M allows the use of waste heat from unpolluted air. In the simplest case the plug-in device draws the warm air directly via the integrated radial fan and cools it down. The refrigerating circuit "pumps" the extracted heat to a usable temperature level and discharges it again via a heat exchanger. The heating water circuit, to be connected externally, directs the usable waste heat to the heating system or a water cylinder with integrated heat exchanger.

The highest efficiency is reached when the heat pump module is operated at a low temperature level to, e.g., heat a preheating stage for domestic hot water preparation.

The heat pump is designed exclusively for heating heating water and domestic hot water!

The heat pump is suitable for mono-energy operation via the heat exchanger down to an external temperature of 0 °C.

⚠ **ATTENTION!**

Due to the lower operating limit the heat pump module can cool the installation location down to 0 °C. Frost protection must be ensured.

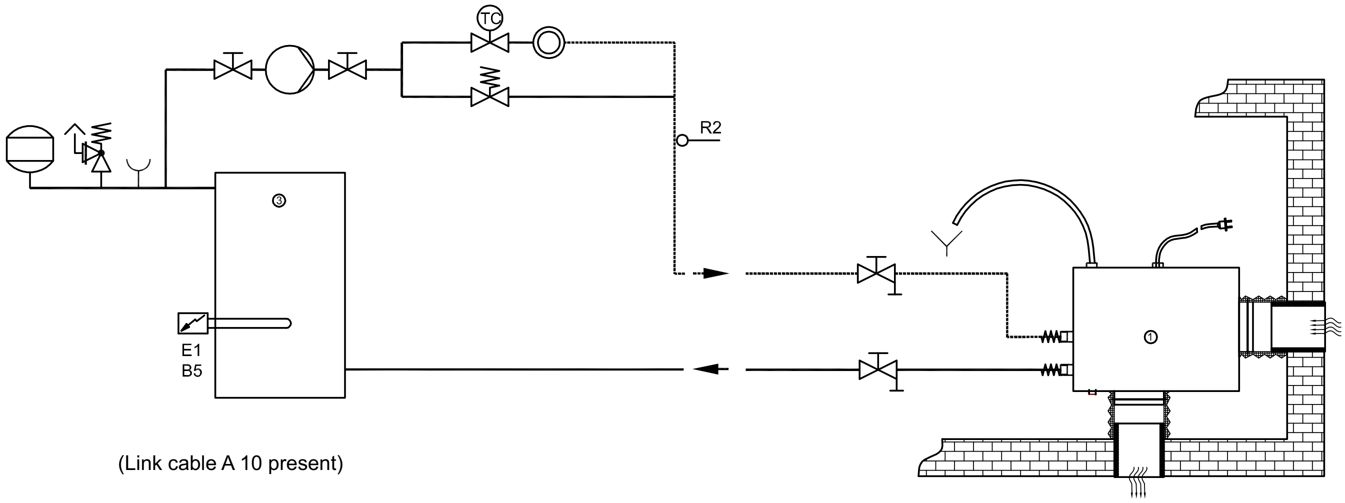
Proper defrosting of the evaporator is guaranteed by maintaining a heating water return temperature of more than 18 °C or 20 °C (see Appendix Operating Range) during continuous operation.

The following is not permitted:

- Operating the pump with solvent-based or explosive exhaust air
- connecting extractor hoods to the ventilation system
- utilising exhaust air containing grease residues

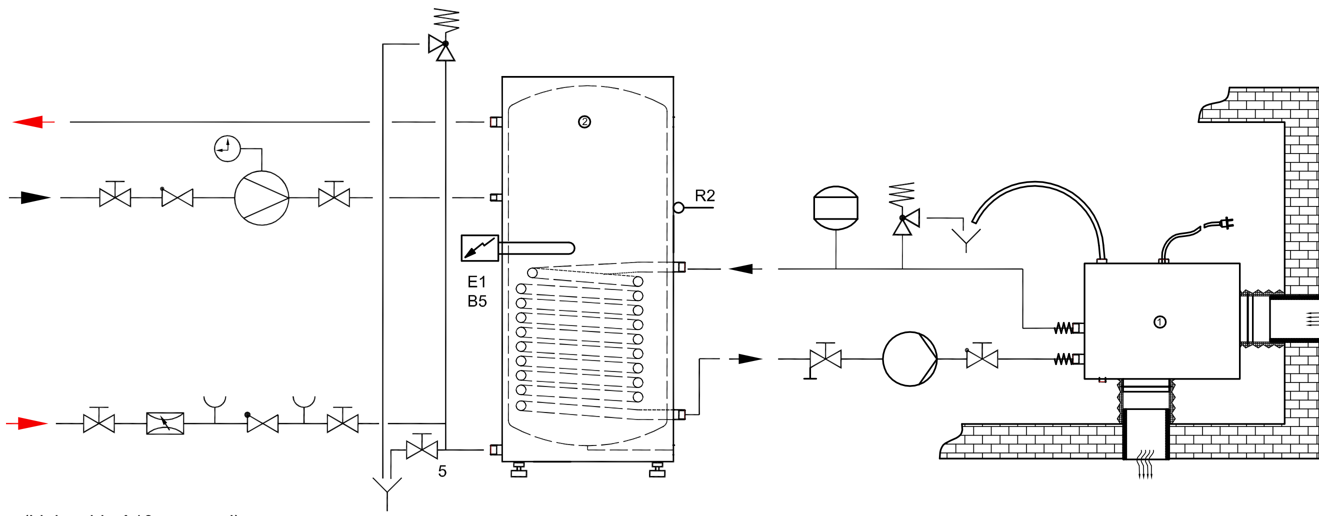
6.2.2 Integration Diagram

6.2.2.1 Integration for heating support



(Link cable A 10 present)

6.2.2.2 Integration for domestic hot water preparation



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6.3 Heating domestic hot water with the domestic hot water heat pump

The domestic hot water heat pump is a ready-to-use heating device whose main components are a domestic hot water cylinder, the components of the refrigerant, air and water circuits and the control, regulation and monitoring devices required for automatic operation. With the help of electrical energy, the domestic hot water heat pump uses the heat stored in the drawn-in air for domestic hot water preparation.

Falling exhaust air temperatures reduce heat pump's heat output and increase the heat-up time. In order for the heat pump to be operated economically, the air intake temperature should not fall below 15°C.

The electric heating element fulfills four functions:

Supplementary heating

The heating-up period is approx. halved by switching on the heating element in addition to the heat pump.

Frost protection

With the BWP 30HS version, the electric heating element switches on automatically and heats the water (nominally) up to the domestic hot water setpoint temperature if the air intake temperature falls below 8 ±1.5 °C. With the BWP 30HSD version, the heating element switches on automatically, and heat pump operation is deactivated, when this temperature falls below -8 ±1.5 °C. When the temperature is below 8 °C, the heating element is switched on if the setpoint temperature has not been reached after a period of 8 hours. This function is inactive if the domestic water is heated by a 2nd heat generator via the internal heat exchanger. The domestic hot water temperature produced by the heating element in the frost protection function may exceed the set setpoint temperature.

Emergency heating

In the event of a heat pump fault, the domestic hot water supply is maintained by the heating element.

Thermal disinfection

Using the operator panel keypad, domestic hot water temperatures above 60 °C (up to 75 °C) can be programmed via the "thermal disinfection" menu. Above 60 °C, these temperatures are reached by the heating element. For higher temperatures to be reached, the adjusting screw (Chapt. 2.3 on page 22) on the temperature controller casing must be turned to the right-hand stop.

NOTE

When the domestic hot water temperature reaches > 60 °C, the heat pump switches off and the domestic hot water is heated solely by the heating element. The factory setting for the heating element controller is 65°C.

The water installations for the heating system are to be carried out according to DIN 1988.

Condensate drain

The condensate hose is attached to the rear of the device. It should be routed so that the condensate produced can flow away without obstruction. The condensate should be drained into a U bend.

The domestic hot water heat pump is wired ready for use: only the mains plug needs to be plugged into a socket in the building equipped with an earthing contact.

NOTE

Connection to a heat pump meter is possible if the domestic hot water heat pump is installed permanently.

6.3.1 Functional description of the domestic hot water heat pump with electric controller

Various operating modes or time programs can be set on the controller of the domestic hot water heat pump. On the domestic hot water heat pumps BWP 30HS and BWP 30HSD, there is still the option of connecting a 2nd heat generator via an integrated heat exchanger (1.45 m²) or combining the heat pump with a photovoltaic plant.

Operating modes

A maximum of two independent shut-off times can be programmed on the controller. During the shut-off times, the cylinder is kept at an adjustable minimum temperature in order to avoid loss of comfort. All other programs are available during this time.

With the integrated heating element, the cylinder is heated as soon as the operating ranges of the heat pump are not reached. Using the "Rapid heating" key, it is possible to select whether the heating element should be active within a set period of time or whether it should be permanently active.

Ventilation

The ventilation function can be activated. This function comes into use when the heat pump is switched off, i.e. no domestic hot water request is pending. In this case, the heat pump's fan continues to run according to the setpoint. This should ensure a minimum quantity of exhaust air independent of heat pump operation, e.g. in the case of commercial waste heat recovery.

Combination with a second heat generator

An existing heat generator or solar system can be used to heat the by using the integrated tube heat exchanger (1.45 m²). For this purpose, a circulating pump can be activated by the controller.

The use of a 2nd heat generator must be activated in the menu. The 2nd heat generator is requested when the heat pump's operating limits are exceeded, i.e. when the upper or lower air intake temperature limit or the maximum permitted domestic hot water temperature is exceeded. In this case, the 2nd heat generator has priority over the heating element in the heat pump. When the 2nd heat generator is activated, it is additionally possible to select a switching temperature which deviates from the lower operating limit (air temperature). If this temperature is undershot, heat pump operation is blocked as soon as the set temperature is reached, and the 2nd heat generator is then used.

Alternatively, the domestic hot water heat pump can also be operated in combination with a thermal solar energy system. The solar circulating pump (accessory) is switched on and the heat pump switched off as soon as a solar gain is detected. The circulating pump is switched off again when a solar gain is no longer available or when a temperature limit value is exceeded, either on the collector or in the cylinder. The solar function has priority over heat pump operation and the heating element.

ATTENTION!

The collector sensor must be a temperature sensor with the resistance characteristic curve of a PT1000.

Combination of domestic hot water heat pump and a photovoltaic plant

The domestic hot water heat pumps BWP 30HS/HSD can also be combined with a photovoltaic plant. To this end, the heat pump controller can be connected with an additional evaluation unit (e.g. inverter checker) via a floating input - the additional evaluation unit must have a floating NO contact. If sufficient output is available from the photovoltaic plant in "Photovoltaic mode", the heat pump is started via the NO contact and is set to the setpoint for photovoltaic operation. The solar function has priority over the photovoltaic function. The display shows that the heat pump is being operated using electricity from the photovoltaic installation.

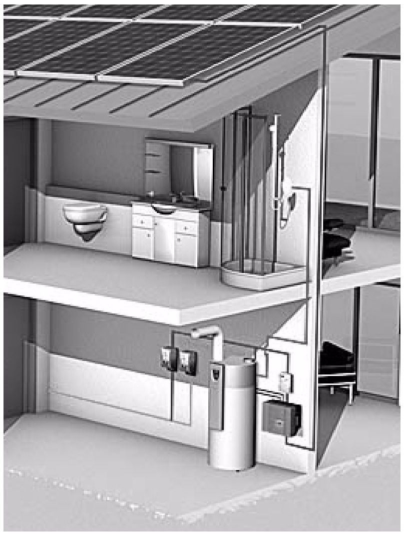


Fig. 6.7: Domestic hot water heat pump combined with a photovoltaic plant

If the output of the photovoltaic plant is not sufficient, the domestic hot water heat pump is operated exclusively with power from the energy provider grid. Excess solar power is fed into the power grid via an inverter.

In the case of domestic hot water heat pumps equipped with an additional internal heat exchanger, a relay with a floating contact automatically switches on a second heat generator according to need.

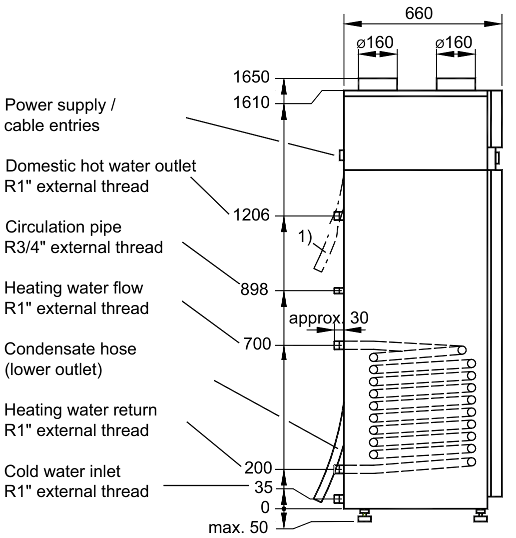


Fig. 6.8: Connections and dimensions of the domestic hot water heat pump equipped with an auxiliary internal heat exchanger
[1)] alternative condensate guidance

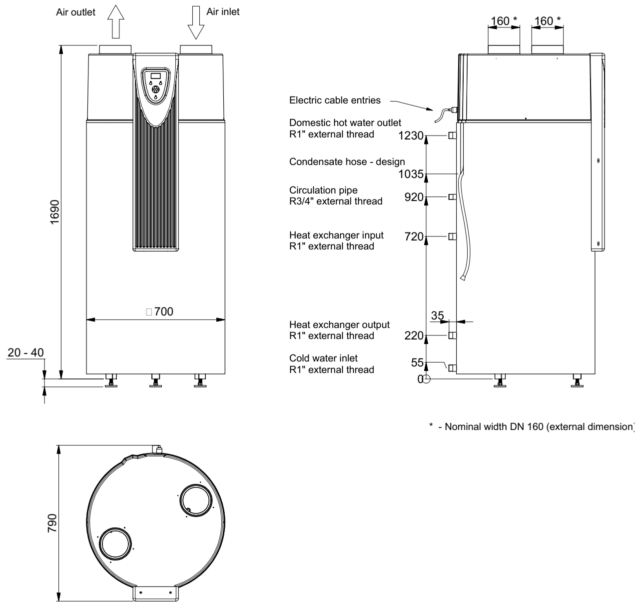


Fig. 6.9: Connections and dimensions of the BWP 30HLW domestic hot water heat pump equipped with an additional internal heat exchanger

6.3.2 Installation

Installation location criteria:

- The domestic hot water heat pump must be installed in a dry and frost-free room.
- Furthermore, installation and air intake is not permitted in rooms with air which is potentially explosive because of gases, vapours or dust.
- In order to prevent damage to interior walls caused by dampness, it is recommended to provide good thermal insulation between the room into which the exhaust air is released and the neighbouring rooms.
- Condensate drainage (with a siphon) must be provided.
- Drawn-in air must not be excessively contaminated or contain large amounts of dust.
- The load-bearing capacity of the foundation must be sufficient (the weight of the filled domestic hot water heat pump is approx. 450 kg!).

To ensure smooth operation and facilitate repair and maintenance work, there should be minimum clearances of 0.6 m on all sides of the device as well as a minimum room height of approx. 2.50 m for operation in “free venting” installation setup (without air ducts/hoses or bends) with domestic hot water heat pump installation.

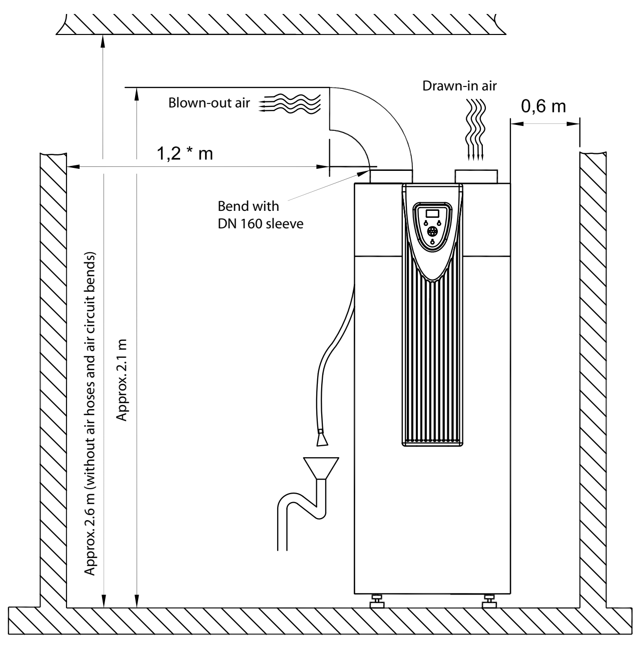


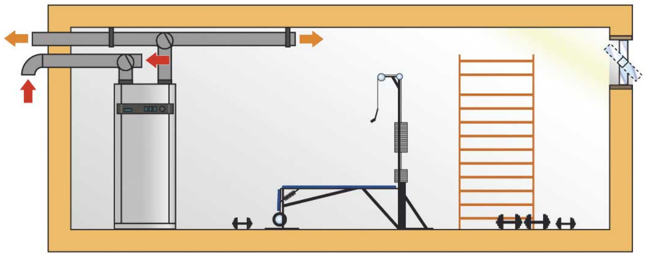
Fig. 6.10: Installation conditions for free process air intake and outlet.
[*)] Minimum clearance between the air outlet in the air circuit bend and the wall is 1.2 m

Air hoses can be optionally connected on both the air inlet and the air outlet side. These should not exceed a total length of 10 m. Flexible, thermally-insulated and sound-insulated DN 160 air hoses are available as accessories.

6.3.3 Ventilation variants

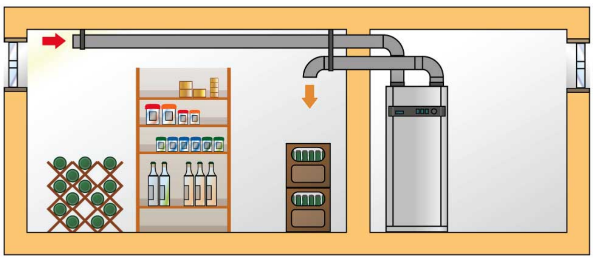
Variable switching of the intake air

A pipe duct system with integrated bypass flap allows the variable use of the heat extracted from outdoor or indoor air for domestic hot water preparation (lower operating limit: + 8 °C).



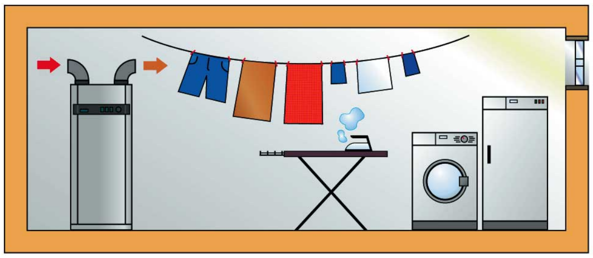
Cooling in recirculating air operation

Indoor air is removed by suction from storage rooms or wine cellars, and is then cooled and dehumidified in the domestic hot water heat pump and blown out again. Suitable locations for installation include hobby rooms, furnace rooms and laundry rooms. The air ducting in the heated section of the system should be insulated with water-proof insulation to prevent the formation of condensate.



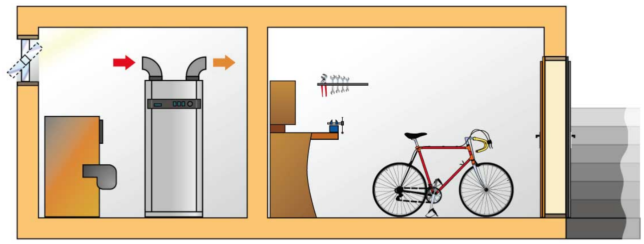
Dehumidifying in recirculating air operation

Dehumidified air in laundry rooms can be used to dry laundry and prevents damage caused by dampness.



Waste heat is useful heat

Our standard heat exchangers (AWP 30HLW and BWP 30HLW only) for domestic hot water heat pumps enable direct connection of a second heat generator, e.g. a solar energy system or a boiler.



6.3.4 Domestic hot water heat pumps for indoor air as a heat source

The domestic hot water heat pump BWP 20A uses exhaust air from living spaces (approx. 20 °C) as a heat source for domestic hot water preparation. This way it is possible to implement simple and economical combination of controlled ventilation and domestic hot water preparation. With a cylinder volume of 200 l the device is especially suited for use in flats and apartments. The installation dimension of 60 cm allows covering with a front panel. The device has an optional connection for an air distribution system with nominal width DN 125.

i NOTE

Further, more detailed information on BWP 20A can be found online, in the download area at www.dimplex.de.

6.4 Domestic ventilation units for domestic hot water preparation

New types of materials and construction materials have made it possible to significantly reduce heating energy consumption. Optimum thermal insulation combined with a good seal on the outer shell of the building ensures that almost no heat is lost to the outside air. On the other hand, extremely well sealed windows prevent the necessary exchange of air in both old buildings and new buildings. This effect leads to contamination of the indoor air. Water vapour and pollutants accumulate in the air and must be actively discharged.

How to ventilate correctly?

Probably the simplest way to ventilate a room is to refresh the air by opening a window. Ventilation at regular intervals by briefly opening the windows is recommended to maintain an acceptable living environment. To do this several times daily in all rooms is tiresome, time-consuming and on account of today's typical work and living habits totally infeasible.

Automatic room ventilation with heat recovery ensures that the air that needs to be exchanged from both a hygienic and constructional standpoint is exchanged in an energy-conscious and economically feasible manner.

Advantages of domestic ventilation units

- Fresh, clean air without indoor air pollutants and excessive humidity
- Automatic management of the required number of daily ventilation procedures without requiring active assistance
- Reduced ventilation losses through heat recovery
- Integrated filter for insects, dust and fine particle pollutants
- Shielding from external noise and increased security with closed windows
- Positive evaluation according to the German Federal Energy Efficiency Ordinance (EnEV)

The use of a mechanical domestic ventilation unit with heat recovery is essential in many cases. The preferred type of waste heat recovery should be clarified before making a decision regarding which type of ventilation system to install.

It makes sense to use the exhaust air from the de-aeration and ventilation of living quarters as an energy source for preparing domestic hot water, because buildings require both ventilation and domestic hot water **all year round**. A second heat generator should be integrated whenever domestic hot water consumption is high.

Dimplex offers a selection of different exhaust air systems with domestic hot water heat pumps

Order reference	Cylinder capacity l	Air volume flow m³ / h	Application
LWP 200	200	140	Residential units up to approx. 110 m²
LWP 300W	290	230	Residential units up to approx. 160 m²

Table 6.4: Ventilation units with domestic hot water heat pumps

i NOTE

Further information on the design of ventilation units and our current product portfolio is available on our website under Ventilation technology.

6.5 Comparison of the convenience and the costs of different types of domestic hot water heating systems

6.5.1 Decentralized domestic hot water supply (e.g. continuous-flow heaters)

Advantages in comparison to heat pumps for heating purposes:

a) Smaller investment

b) Minimal space requirement

c) Increased heat pump availability for space heating (particularly in the case of monovalent operation and during shut-off times)

d) Low water losses

e) No downtime losses or circulation losses

Disadvantages in comparison to heat pumps for heating purposes:

a) Higher operating costs

b) Loss of comfort because the domestic hot water temperatures are dependent on the tap speed (in the case of hydraulic devices)

6.5.2 Cylinder with electric immersion heater (off-peak electricity)

Advantages in comparison to heat pumps for heating purposes:

a) Smaller investment
b) Higher domestic hot water temperatures possible in the cylinder (but often not required!)
c) Increased heat pump availability for space heating (particularly in the case of monovalent operation and during shut-off times).

Disadvantages in comparison to heat pumps for heating purposes:

a) Higher operating costs
b) Only limited availability
c) Increased lime scaling possible
d) Longer heating-up periods

6.5.3 Domestic hot water heat pumps

Advantages in comparison to heat pumps for heating purposes:

a) A cooling or dehumidification effect can be produced at the installation location (e.g. storage cellar) in the summertime
b) Increased heat pump availability for space heating (particularly in the case of monovalent operation and during shut-off times)
c) Easy integration of solar thermal systems
d) Higher domestic hot water temperatures when only the heat pump is in operation

Disadvantages in comparison to heat pumps for heating purposes:

a) Considerably longer domestic hot water cylinder reheating times
b) Heat output is normally insufficient if the domestic hot water consumption is high
c) The installation room could become cold in the wintertime

6.5.4 Domestic ventilation unit with domestic hot water preparation

Advantages in comparison to heat pumps for heating purposes:

a) Comfortable domestic ventilation to ensure hygienic air circulation
b) Domestic hot water preparation using active year-round heat recovery from exhaust air
c) Increased heat pump availability for space heating (particularly in the case of monovalent operation and during shut-off times)
d) Easy integration of solar thermal systems
e) Higher domestic hot water temperatures when only the heat pump is in operation

Disadvantages in comparison to heat pumps for heating purposes:

a) Considerably longer domestic hot water cylinder reheating times with heat pump operation
b) Combination with a second heat generator is essential if the domestic hot water consumption is high

6.5.5 Summary

Heating domestic hot water with a heat pump is practical and economical on account of the good performance factor.

Domestic hot water for normal usage should be prepared using a domestic ventilation unit if living space ventilation is necessary or desired. The integrated air-to-water heat pump extracts the stored energy in the exhaust air and utilises it for year-round domestic hot water preparation.

Electric domestic hot water appliances can also be appropriate depending on the tariff structure of the local utility company, the domestic hot water consumption, the required temperature level and the location of the extraction points.

7 Heat pump manager

The heat pump manager is essential for the operation of air-to-water, brine-to-water and water-to-water heat pumps. It regulates a bivalent, monovalent or mono energy heating system and monitors the safety components in the refrigeration circuit. The heat pump manager is either installed in the heat pump casing or is delivered with the heat pump as a wall-mounted controller. It carries out regulation of both the heating system and the heat source system.

Overview of functions

- Convenient 6-button operation
- Large, clear, illuminated LCD with indicators for operating status and service information
- Conforms with utility company requirements
- Dynamic menu navigation, customised for the configured heat pump system
- Automatic
  operating mode switching to auto, summer, or cooling based on the outside temperature.
- Remote display interface with identical menu navigation
- Return temperature controlled regulation of heating operation based on outside temperature, adjustable fixed-setpoint or room temperature.
- Control of up to three heating circuits
- Controlling a dew point controller in cooling operation
- Priority switching
  – Cooling first
  – Domestic hot water preparation first
  – Heating first
  – Swimming pool
- Controlling a 2nd heat generator
  (oil or gas boiler, immersion heater)
- Controlling a mixer for a 2nd heat generator (oil, gas, solid fuel boiler, or renewable heat source)
- Special program for a 2nd heat generator to ensure minimum runtimes (oil boiler) or minimum heating times (main cylinder)
- Control of a flange heater for targeted reheating of domestic hot water with adjustable time programs, and for thermal disinfection
- Controlling a circulation pump via impulse or time programs
- Optional control of up to 5 circulating pumps
- Defrost management system to minimise the energy required for defrosting using variable, self-adjusting defrosting cycle times
- Controlling primary and secondary pumps via a
  0-10V signal
- Compressor management system to ensure balanced loading of the compressors for heat pumps with two performance levels
- Operating hours counter for compressors, circulating pumps, 2nd heat generator and flange heater
- Keyboard block, child lock
- Ten alarm memories with time, date and error description
- Interface for connecting additional communication options for LAN, EIB/KNX, Modbus
- Automatic program for targeted heat drying of screed floors and saving the start and finish times
- Remote control for the heat pump manager via an App specifically for iPhone and iPad

7.1 Operation

- The heat pump manager is operated using 6 keys: ESC, MODUS, MENUE, ⇓, ⇑, ↵. Different functions are assigned to these buttons according to the current display (Standard or Menu).
- The operating status of the heat pump and the heating system is indicated in plain text on a 4 x 20 character LC display (see Fig. 7.1 on page 75).
- Six different operating modes can be selected: Cooling, Summer, Auto, Party, Vacation, 2nd heat generator.
- The menu is made up of three main levels: Settings, Operating data, History (see Table 7.3 on page 81).

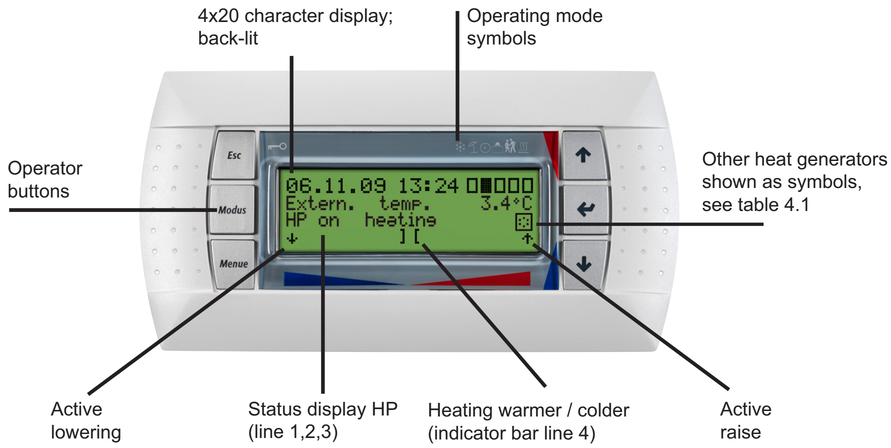


Fig. 7.1: Heat pump manager WPM 2007 or WPM Econ Plus with dropped standard LC display with operator buttons

NOTE

The contrast of the display can be brightened with the key combination (ESC), (MODUS), and (⇧) or darkened with (ESC), (MODUS), and (⇩) All three keys must be pressed and held together until the required contrast level is set.

NOTE

Keyboard block, child lock

To activate the keyboard block, press and hold the (ESC) key for approximately five seconds. When activated, the keyboard block symbol appears on the display. To release the keyboard block, press and hold the (ESC) key for approximately five seconds.

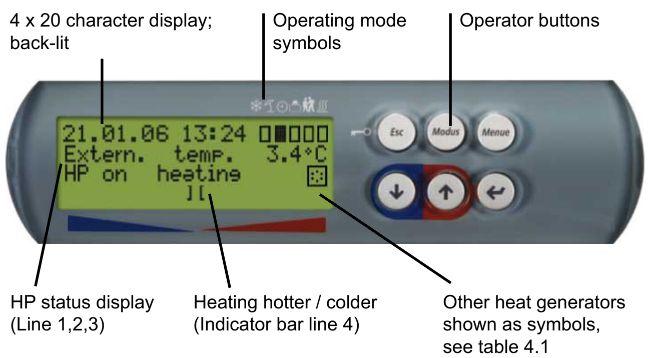


Fig. 7.2: Heat pump manager WPM 2006 with integrated standard LC display with operator buttons

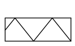
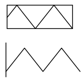
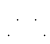
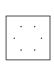
	**Pipe heater**
	**Immersion heater**
	**Oil boiler**
	**Flange heater**
	**Supplementary heating**

Table 7.1: Symbol display (from software version L07)

Button	Standard display (see Fig. 7.1 on page 75)	Change of setting
ESC	■ Activates or deactivates the keyboard block ■ Acknowledges a fault	■ Exits the menu and returns to the main display ■ Returns from a submenu ■ Exits a setting without saving changes
Modus	■ Selection of the operating mode	No action
Menue	■ Jumps to menu	No action
⇓	■ Shifts the heating curve downwards (colder)	■ Scrolls downwards between menu items on one level ■ Lowers the value of a setting
⇑	■ Shifts the heating curve upwards (hotter)	■ Scrolls upwards between menu items on one level ■ Raises the value of a setting
↵	No action	■ Selects a setting value in the corresponding menu item. ■ Exits a setting and saves changes ■ Jumps to a submenu

Table 7.2: Operator button functions

7.2 Temperature sensor (heating controller N1)

Depending on the heat pump type used, the following temperature sensors are already installed or must be additionally mounted:

- Outside temperature (R1) (see Chapt. 7.2.3 on page 77)
- Temperature 1st, 2nd and 3rd heating circuit (R2, R5 and R13) (see Chapt. 7.2.4 on page 77)
- Flow temperature (R9), as a frost protection sensor in the case of air-to-water heat pumps
- Outlet temperature of the heat source in the case of brine-to-water and water-to-water heat pumps (R6)
- Inlet temperature of the heat source in the case of brine-to-water and water-to-water heat pumps (R24)
- Domestic hot water temperature (R3)
- Temperature of renewable heat accumulator (R13)
- The heating controller N1 is available in 2 versions (Chapt. 7.2.1 on page 76 and Chapt. 7.2.2 on page 77)

	Temperature in °C																
	-20	**-15**	**-10**	**-5**	**0**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
Standard NTC-2 in kΩ	14.6	11.4	8.9	7.1	5.6	4.5	3.7	2.9	2.4	2.0	1.7	1.4	1.1	1.0	0.8	0.7	0.6
NTC-10 in kΩ	67.7	53.4	42.3	33.9	27.3	22.1	18.0	14.9	12.1	10.0	8.4	7.0	5.9	5.0	4.2	3.6	3.1

7.2.1 Heat pump manager WPM 2006 plus with integrated display

All temperature sensors to be connected to the heat pump manager with integrated display must correspond to the sensor characteristic curve shown in Fig. 7.4 on page 76.

Fig. 7.3: Heat pump manager WPM 2006plus with integrated display

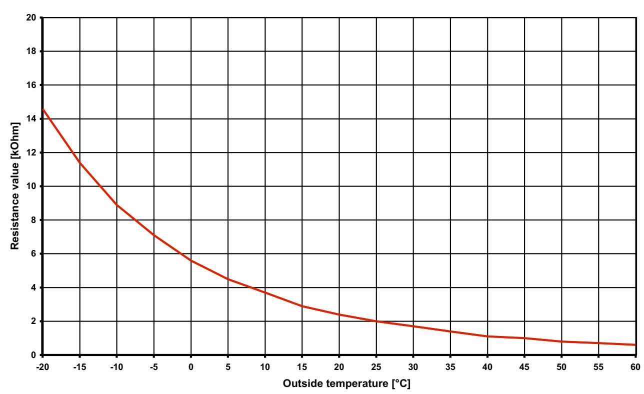


Fig. 7.4: Standard NTC-2 sensor characteristic curve according to DIN 44574 for connecting temperature sensors to the heat pump manager with integrated display

7.2.2 Heat pump manager WPM 2007plus/ WPM EconPlus with removable control panel

All temperature sensors to be connected to the heat pump manager with removable control panel must correspond to the sensor characteristic curve shown in Fig. 7.6 on page 77. The only exception is the outside temperature sensor included in the scope of supply of the heat pump (see Chapt. 7.2.3 on page 77)

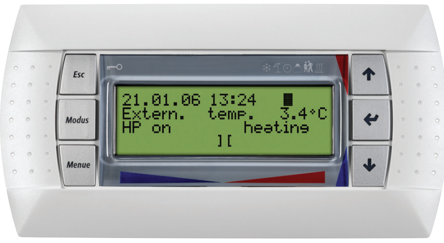


Fig. 7.5: Removable control panel

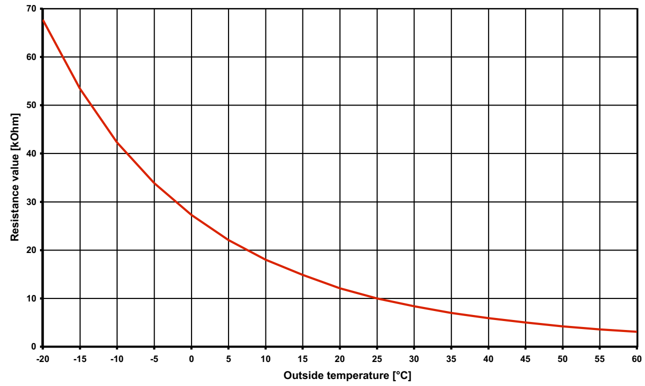


Fig. 7.6: NTC-10 sensor characteristic curve for connection to the heat pump manager with removable control panel

7.2.3 Installing the external sensor

The external sensor must be mounted in such a way that all weather conditions are taken into consideration and the measured value is not falsified.

Installation:

- On the external wall of a heated room used as living space, if possible on the north or north-west side of the building
- Do not install in a “sheltered position" (e.g. in a wall niche or under a balcony)
- Not in the vicinity of windows, doors, exhaust air vents, external lighting or heat pumps
- Not to be exposed to direct sunlight at any time of year

7.2.4 Installing the return sensor

It is only necessary to mount the return sensor if it is included in the scope of supply of the heat pump, but is not integrated.

The return sensor can be fitted as a pipe-mounted sensor or installed in the immersion sleeve of the compact manifold or the dual differential pressureless manifold.

- Remove paint, rust and scale from heating pipe.
- Coat the cleaned surface with heat transfer compound (apply sparingly).
- Attach the sensor with a hose clip (tighten firmly, as loose sensors can cause malfunctions) and thermally insulate.

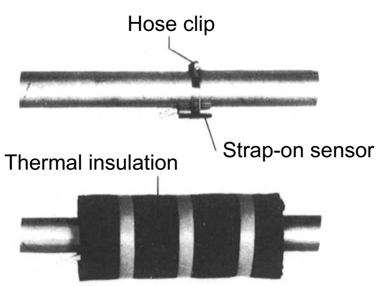


Fig. 7.7: Mounting a pipe-mounted sensor

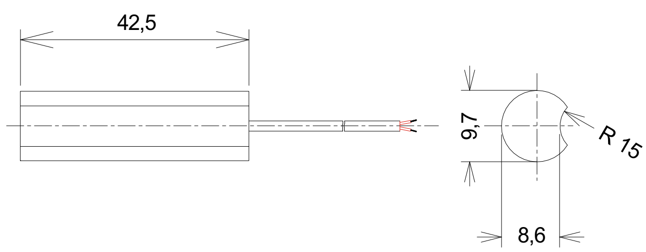


Fig. 7.8: Dimensions of the standard NTC-2 return sensor in a metal casing

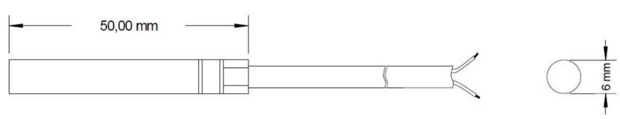


Fig. 7.9: Dimensions of the standard NTC-10 return sensor in a metal casing

7.3 Thermal energy meter WMZ

NOTE

The high-efficiency heat pumps come with an integrated thermal energy meter as standard. Measurement is carried out via pressure sensors in the heating circuit, which are directly linked to the heat pump manager WPM EconPlus.

General description

The thermal energy meter (WMZ 25/32), for connection to the heat pump manager, is used for the measurement and evaluation of the thermal energy emitted by the heat pump.

Sensors in the flow and return of the heating water pipe and an electronics module acquire the measured values and transmit a signal to the heat pump manager, which, depending on the current operating mode of the heat pump (heating/domestic hot water/swimming pool), totals the thermal energy in kWh and displays them in the menu and history.

NOTE

The thermal energy meter complies with the quality requirements of the German market incentive programme subsidizing efficient heat pumps. The thermal energy meter is not subject to obligatory calibration, and can thus not be used for the heating cost billing procedure!

7.3.1 Hydraulic and electrical integration of the thermal energy meter

The thermal energy meter requires two measuring devices for data acquisition.

- The measuring tube for the flow measurement
  This must be installed in the heat pump flow upstream of the branch for domestic hot water preparation (observe flow direction).
- A temperature sensor (copper pipe with immersion sleeve)
  This must be installed in the heat pump return.

The installation locations for both measuring tubes should be as close to the heat pump as possible in the generator circuit.

To avoid eddying effects which could lead to incorrect measurements, there should be a gap of 50 cm between the measuring devices and other installed components such as pumps or valves.

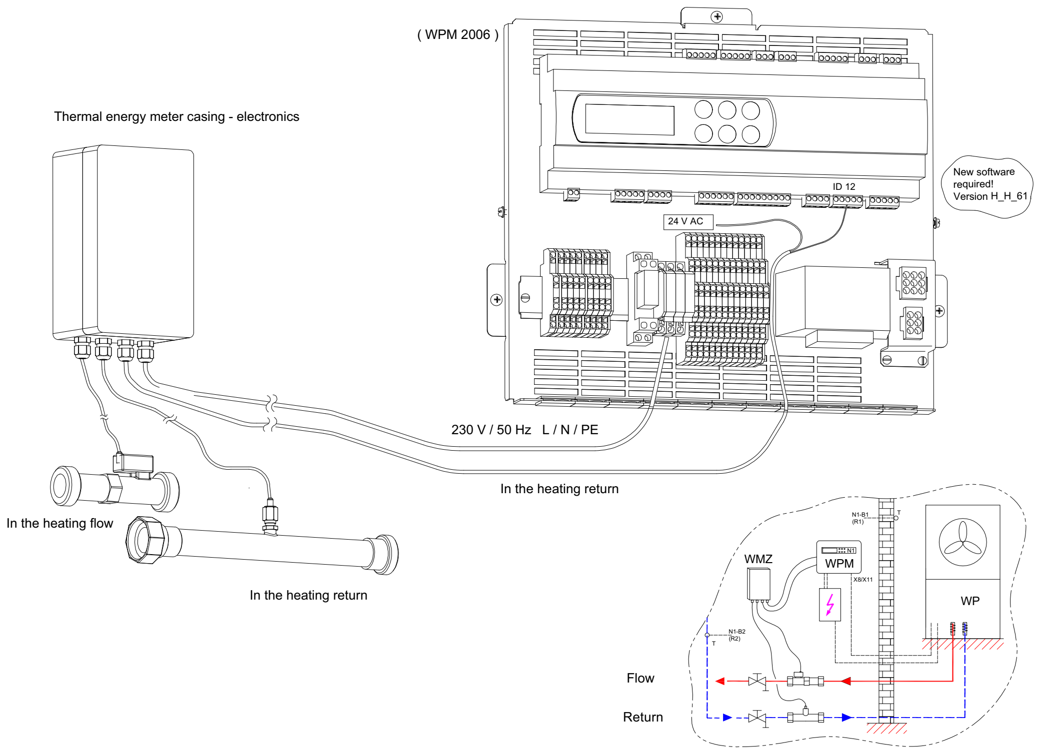


Fig. 7.10: Hydraulic and electrical components of the thermal energy meter

NOTE

Only use pure water in the heating circuit (no mixtures, no antifreeze)!

The control PCB of the electronics module requires its own voltage supply, which can be tapped either from the mains power supply or from the terminal strip (mains L/N/PE ~230 VAC) of the heat pump manager.

A signal line which transmits the pulse must be connected between terminals X2/1/2 of the electronics module and the heat pump manager (N1).

Terminal diagram:

Thermal energymeter WMZ	Heat pump manager WPM
N20/X2-1	24VAC / G
N20/X2-2	N1/J7-ID12

Compact heat pumps

With heat pumps with integrated heating components for an unmixed heating circuit (compact heat pump), the installation of the thermal energy meter within the heat pump (upstream of the branch for domestic hot water preparation) is not possible. In this case the thermal energy meter for the measuring of the heating operation is installed in the heating flow. An additional thermal energy meter can be installed in the domestic hot water flow to ensure optimum domestic hot water preparation.

7.3.2 Settings on the heat pump manager

NOTE

For the evaluation of the pulses by the heat pump manager software version H6x (or higher) is required.

During the pre-configuration of the heat pump manager, "Thermal energy meter" has to be set to "Yes" to activate thermal energy metering. Depending on the system settings, the history menu shows the values for heating, domestic hot water and/or swimming pool. The emitted thermal energy is displayed in kWh.

The counter can be reset in the "Operating data" menu!

7.4 Solar controller for heat pump manager WPM Econ SOL

Wall-mounted solar controllers with temperature sensors for recording the collector and cylinder temperature without graphic display. The extension module is connected to the existing heat pump manager and provides the additional inputs and outputs required for solar control. Can be used for a heat pump heating system with a collector array and solar energy supply in a buffer tank. The cylinder temperature and the collector circuit temperature are shown in the heat pump manager display.

Equipment WPM Econ Sol

- Adjustable collector cooling function
- Pump kick function
- Cylinder maximum temperature
- Incl. NTC 10 (collector) and PT 1000 (cylinder) temperature sensors
- Graphic display on the heat pump manager

7.5 General menu structure

The heat pump manager provides numerous setting and control parameters (see *Table 7.3 on page 81*)

Pre-configuration

The preconfiguration tells the heat pump manager which components are connected to the heat pump heating system. Preconfiguration must be carried out before the actual configuration in order to be able to show or hide system-specific menu items (dynamic menus).

Configuration

The menus for “Outputs”, “Inputs”, “Special functions” and “Modem”, as well as the extended setting menu, can be selected in the menu level for experts.

- Pre-configuration
  - Operating mode
  - Thermal energy meter
  - Additional heat exchanger, domestic hot water
  - Thermal energy meter / additional heat exchanger
  - External 4-way valve
  - Hydraulic design
  - Active cooling function
  - Passive cooling function
  - Passive cooling function system design
  - 1st/2nd/3rd heating circuit
  - Domestic hot water preparation
    - Request by
    - Flange heater
    - Circulation
  - Swimming pool water preparation
    - Request by
  - Low pressure brine - measurement present
  - Low pressure brine

- Settings
  - Time
  - Mode
    - Automatic operating mode switching
    - Operating mode
    - Party mode - number of hours
    - Vacation mode - number of days
  - Heat pump
    - Number of compressors
    - Fan
      - Fan lower Time 1 Time 2
      - Fan lower MON ... SUN
    - Standard heat output
    - Brine limit protection
    - Flow rate switch for primary
    - Flow rate switch for secondary
  - 2nd heat generator
    - HG2 limit value
    - HG2 mode of operation
    - HG2 mixer runtime
    - HG2 mixer hysteresis
    - Utility block (EVU)
    - HG2 limit temp. Utility3
    - HG2 special program
    - HG2 overtemperature bivalent-renewable
    - HG2 swimming pool overtemperature bivalent-renewable
  - Heating/cooling circuit 1
    - HC 1 control via
    - HC 1 heating curve end point (-20°C)
    - HC1 fixed setpoint Return set temp.
    - HC 1 room controller room set temperature heating
    - HC 1 return min. temperature
    - HC 1 return max. temperature
    - HC1 hysteresis return set temperature
    - HC1 time program lower
      - HC1 Lower
      - HC1 lower value reduction
      - HC 1 lower MON ... SUN
    - HC 1 time program raise
      - HC 1 raise Time1 ... Time2
      - HC1 raise raise value
      - HC 1 raise MON ... SUN
    - Dynamic cooling set return value
    - Silent cooling room set temperature
    - Silent cooling dew point distance
  - Heating/cooling circuit 2/3
    - HC 2/3 control via
    - HC 2/3 temperature sensor
    - HC 2/3 heating curve end point (-20°C)
    - HC 2/3 colder / warmer
    - HC2/3 fixed setpoint Set temp.
    - HC 2/3 return maximum value
    - HC 2/3 mixer hysteresis
    - HC 2/3 mixer runtime
    - HC 2/3 time program lower
      - HC2/3 lower
      - HC 2/3 lower value reduction
      - HC 2/3 lower MON ... SUN
    - HC 2/3 time program raise
      - HC2/3 raise Time1 ... Time2
      - HC 2/3 raise - raise value
      - HC 2/3 raise MON ... SUN
    - HC 2/3 silent cooling room set temperature
    - HC 2/3 silent cooling dew point distance
  - Cooling
    - Dynamic cooling block
      - Dyn. cooling Time1 Time2
      - Dyn. cooling MON ... SUN
    - 2nd chiller
    - Limit cooling outside temperature
  - Domestic hot water
    - Domestic hot water switch comp2
    - Domestic hot water hysteresis
    - Domestic hot water parallel cooling - DHW
    - Domestic hot water set temperature
    - Domestic hot water max. temp. - parallel
    - Domestic hot water parallel heating - DHW
    - Domestic hot water set temperature
    - Domestic hot water block
      - Domestic hot water block Time1 Time2
      - Domestic hot water block MON... SUN
    - Thermal disinfection
      - Thermal disinfection start
      - Thermal disinfection temperature
      - Thermal disinfection MON ... SUN
    - Domestic hot water switch-off delay
    - Domestic hot water circulation
      - Domestic hot water circulation Time1 Time2
      - Domestic hot water circulation MON... SUN
    - Domestic hot water reset HP maximum
  - Swimming pool
    - Swimming pool switching 2nd compressor
    - Swimming pool set temp.
    - Swimming pool set temp. max. cooling
    - Swimming pool hysteresis
    - Swimming pool block
      - Swimming pool block Time1 ... Time2
      - Swimming pool block MON ... SUN
    - Swimming pool priority
      - Swimming pool priority start
      - Swimming pool priority number of hours
      - Swimming pool priority MON ... SUN
  - System - pump control
    - Auxiliary pump for heating
    - Auxiliary pump for cooling
    - Auxiliary pump for domestic hot water
    - Auxiliary pump for swimming pool
    - Auxiliary pump with bivalent
    - Heating pump optimization
    - Secondary pump flow
    - Secondary pump follow-up

		M13 with passive cooling
		M11 with passive cooling
	Date Year Day Month Day of week	
	Language	
Operating data		
	Outside temperature	
	Return set temp. Heating/cooling circuit 1	
	Return temp. Heating circuit 1	
	Flow temp. Heat pump	
	Minimum temperature - cooling circuit 1	
	Temperature heating/cooling circuit 1	
	Set temp. Heating/cooling circuit 2/3	
	Minimum temperature - cooling circuit 2/3	
	Temperature heating/cooling circuit 2/3	
	Heating request	
	Performance level	
	Defrost end sensor	
	Temperature cylinder renewable	
	Return temperature passive cooling	
	Flow temperature passive cooling	
	Hot gas temperature	
	Room temperature 1	
	Humidity room 1	
	Room temperature 2	
	Humidity room 2	
	Cooling request	
	Domestic hot water set temp.	
	Domestic hot water temperature	
	Domestic hot water request	
	Swimming pool temperature	
	Swimming pool request	
	Brine limit protection sensor	
	High pressure sensor	
	Low pressure sensor	
	Heat source inlet	
	Coding	
	software	
	quantity of thermal energy	
History		
	Compressor 1 runtime	
	Compressor 2 runtime	
	2nd heat generator runtime	
	Primary pump runtime	
	Fan runtime	
	Heating pump runtime	
	Cooling runtime	
	Domestic hot water pump runtime	
	Swimming pool pump runtime	
	Flange heater runtime	
	Alarm memory	
	Heating function program begin / end	
	Screed drying begin / end	
	quantity of thermal energy	
Outputs		
	Compressor 1	
	Compressor 2	
	Four-way valve	
	Fan / primary pump	
	Primary pump cooling	
	Heat generator 2	
	Mixer open - heat generator 2	
	Mixer closed - heat generator 2	
	Mixer open - heating circuit 3	
	Mixer closed - heating circuit 3	
	Mixer open renewable	
	Mixer closed renewable	
	Heating pump	
	Heating pump - heating circuit 1/2	
	Mixer open - heating circuit 2	
	Mixer closed - heating circuit 2	
	Auxiliary pump	
	Cooling pump	
	Switch room thermostat	
	Reversing valves, cooling	
	Domestic hot water pump	
	Flange heater	
	Swimming pool water pump	
	Circulation pump	
Inputs		
	Low pressure switch	
	High pressure switch	
	Defrost end pressure switch	
	Flow rate monitoring primary/secondary	
	Hot gas thermostat	
	Brine limit protection thermostat	
	Motor protection compressor	
	motor protection primary pump	
	Utility block (EVU)	
	External block	
	Low pressure switch brine	
	Dew point monitor	
	Domestic hot water thermostat	
	Swimming pool thermostat	
	Circulation system requirements	
Special functions		
	Quick start	
	Deactivate operating	
	Commissioning	
	System control	
		System control primary side
		System control secondary side
		System control domestic hot water pump
		System control mixer
		System control circulation pump
	Initial heating program	
		Initial heating program maximum temperature
		Domestic hot water / swimming pool active
		Heating function program
		Standard program screed drying
		Individual program heating-up period
		Individual program maintaining time
		Individual program heating-down period
		Individual program diff. temp.- heating-up
		Individual program diff. temp. - heating down
		Individual program screed drying
Modem		
	Baud rate	
	Address	
	Protocol	
	Password	

Table 7.3: Menu structure heat pump manager software version Jx

7.6 Electrical connection heat pump manager

7.6.1 Connection work WPM 2006 plus/WPM 2007 plus

1) The four-core **supply cable** for the **output section of the heat pump** is fed from the heat pump meter via the utility company's contactor (if required) into the heat pump (3L/PE~400V,50Hz).
   The system must be protected according to the power consumption data on the type plate using a 3-pole miniature circuit breaker with C characteristic and common tripping for all 3 paths
   Cable cross-section according to DIN VDE 0100
2) The three-core **supply cable** for the **heat pump manager** (heating controller N1) is fed into the heat pump (device with integrated controller) or to the future mounting location of the wall-mounted heat pump manager (WPM).
   The (L/N/PE~230 V, 50 Hz) supply cable for the heat pump manager must have a constant voltage. For this reason, it should be tapped upstream from the utility blocking contactor or be connected to the household current, as important protection functions may otherwise be lost during a utility block.
3) The **utility blocking contactor** (K22) with 3 main contacts (1/3/5 // 2/4/6) and an auxiliary contact (NO contact 13/14) should be dimensioned according to the heat pump output and must be supplied by the customer.
   The NO contact of the utility blocking contactor (13/14) is looped from terminal strip X2 to plug terminal J5/ID3. **CAUTION! Extra-low voltage!**
4) The **contactor** (K20) for the **immersion heater** (E10) of mono energy systems (HG2) should be dimensioned according to the radiator output and **must be supplied by the customer**. It is controlled (230 V AC) by the heat pump manager via the terminals X1/N and J13/NO 4.
5) The **contactor** (K21) for the **flange heater** (E9) in the domestic hot water cylinder should be dimensioned according to the radiator output and **must be supplied by the customer**. It is controlled (230 V AC) by the heat pump manager via the terminals X1/N and J16/NO 10.
6) The contactors mentioned above in points 3, 4 and 5 are installed in the electrical distribution system. The five-core mains cables (3L/N/PE 400 V ~50 Hz) for the radiators should be rated and protected according to DIN VDE 0100.
7) The **heat circulating pump** (M13) is connected to terminals X1/N and **J13/NO 5**.
8) The **domestic hot water circulating pump** (M18) is connected to the terminals X1/N and **J13/NO 6**.
9) The brine or well pump is connected to the terminals X1/N and **J12/NO 3**.
   With air-to-water heat pumps,**a heat circulating pump** must not be connected on this output!
10) The **return sensor** (R2) is either directly integrated in brine-to-water and water-to-water heat pumps or is included in the scope of supply as a separate component.
   The return sensor is integrated in air-to-water heat pumps for indoor installation and is connected to the heat pump manager via two single-core wires in the control cable. Both single-core wires are connected to the terminals X3 (ground) and **J2/B2**.
   With air-to-water heat pumps for outdoor installation, the return sensor must be mounted on the shared heating and domestic hot water return (e.g. immersion sleeve in the compact manifold).
   The connection on the heat pump manager also takes place on the terminals: X3 (ground) and J2/B2.
11) The **external sensor** (R1) is connected to the terminals X3 (ground) and **J2/B1**.
12) The **domestic hot water sensor** (R3) is installed in the domestic hot water cylinder and is connected to the terminals X3 (ground) and **J2/B3**.
13) The heat pump and the heat pump manager are connected to each other (round plug) via coded **control cables** which must be ordered separately in the case of heat pumps installed outdoors. In the case of heat pumps with **hot gas defrosting** only, connect the single-core wire (No.8) to the terminal J4-Y1.

i NOTE

When using three-phase current pumps, a power contactor can be activated with the 230V output signal of the heat pump manager.
Sensor cables can be extended with 2 x 0.75mm cables up to 30 m.

7.6.2 Electrical installation of the heat pump WPM EconPlus

1) The three- or four-core supply cable for the output section of the heat pump is fed from the heat pump meter via the utility company block (if required) into the heat pump (1L/N/PE~230V,50Hz or 3L/PE~400V,50Hz).
   Safeguard according to the power consumption data on the type plate, with a multipole circuit breaker in the **phases with C characteristic and common** tripping for all paths. Cable cross-section according to DIN VDE 0100.
2) The three-core **supply cable** for the **heat pump manager** (heating controller N1) is fed into the heat pump (device with integrated controller) or to the future mounting location of the heat pump manager (WPM).
   The (L/N/PE~230 V, 50 Hz) supply cable for the heat pump manager must have a constant voltage. For this reason, it should be tapped upstream from the utility blocking contactor or be connected to the household current, as important protection functions may otherwise be lost during a utility block.
3) The **utility blocking contactor** (K22) with 3 main contacts (1/3/5 // 2/4/6) and an auxiliary contact (NO contact 13/14) should be dimensioned according to the heat pump output and must be supplied by the customer.
   The NO contact of the utility blocking contactor (13/14) is looped from terminal strip X3/G to plug terminal N1-J5/ID3. **CAUTION! Extra-low voltage!**
4) The **contactor** (K20) for the **immersion heater** (E10) of mono energy systems (HG2) should be dimensioned according to the radiator output and **must be supplied by the customer**. It is controlled (230V AC) by the heat pump manager via terminals X1/N and N1-J13/NO 4.
5) The **contactor** (K21) for the **flange heater** (E9) in the domestic hot water cylinder should be dimensioned according to the radiator output and **must be supplied by the customer**. It is controlled (230V AC) by the heat pump manager via terminals X2/N and N1-X2/K21.
6) The contactors mentioned in points 3, 4 and 5 are installed in the electrical distribution system. The mains cables for the heating elements should be dimensioned and protected according to DIN VDE 0100.
7) The **heat circulating pump** (M13) is connected to terminals X2/N and N1-X2/M13.
8) The **domestic hot water circulating pump** (M18) is connected to terminals X2/N and N1-X2/M18.
9) The return sensor is integrated into air-to-water heat pumps for outdoor installation, and is connected to the heat pump manager via the control cable. The return sensor must be installed in the immersion sleeve in the manifold only when a dual differential pressureless manifold is used. The single-core wires are then connected to terminals X3/GND and X3/R2.1. The A-R2 link cable (which is situated between X3/B2 and X3/1 when delivered) must then be connected to the X3/1 and X3/2 terminals.
10) The **external sensor** (R1) is connected to terminals X3/GND (ground) and N1-X3/R1.
11) The **domestic hot water sensor** (R3) is installed in the domestic hot water cylinder and is connected to terminals X3/GND (ground) and N1-X3/R3.

NOTE

When using three-phase current pumps, a power contactor can be activated with the 230V output signal of the heat pump manager.
Sensor cables can be extended with 2 x 0.75 mm cables up to 40 m.

NOTE

A detailed connection diagram for the heat pump manager WPM EconPlus as shown in Chapter 7.4.4 on page 93 can also be found in the operating cost calculator at www.dimplex.de/betriebskostenrechner at the end of the system layout.

Electrical connection of electronically regulated circulating pumps

Electronically regulated circulating pumps have high starting currents, which may shorten the service life of the heat pump manager. A coupling relay must therefore be installed between the output of the heat pump manager and the electronically regulated circulating pump.

This is not necessary if the maximum permissible operating current of the heat pump manager of 2 A and the maximum permissible starting current of the heat pump manager of 12 A are not exceeded by the electronically regulated circulating pump or a relevant approval has been issued by the pump manufacturer.

ATTENTION!

It is not permitted to connect more than one electronically regulated circulating pump via a relay output.

7.6.3 Connection diagram WPM 2006 plus / WPM 2007 plus

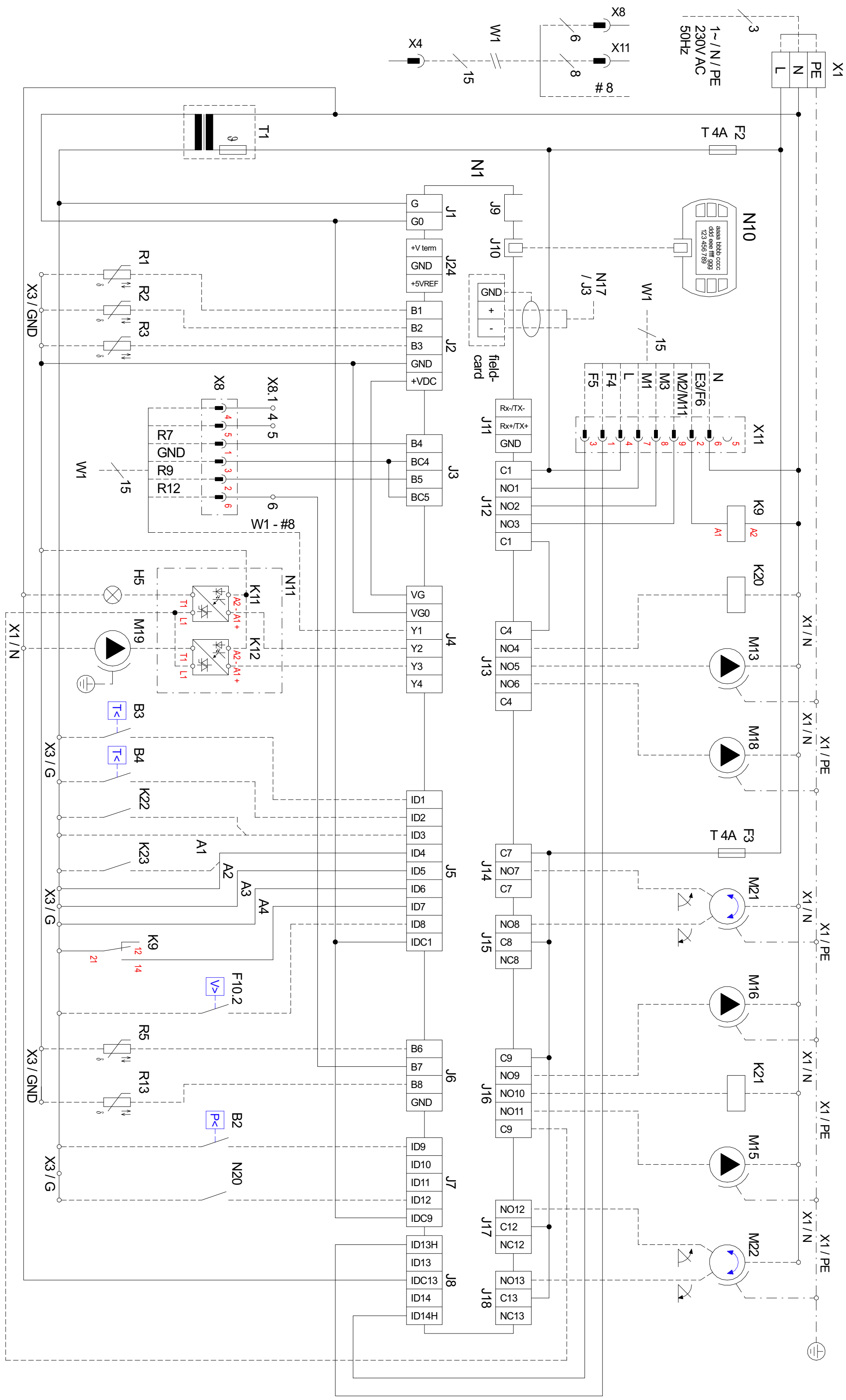
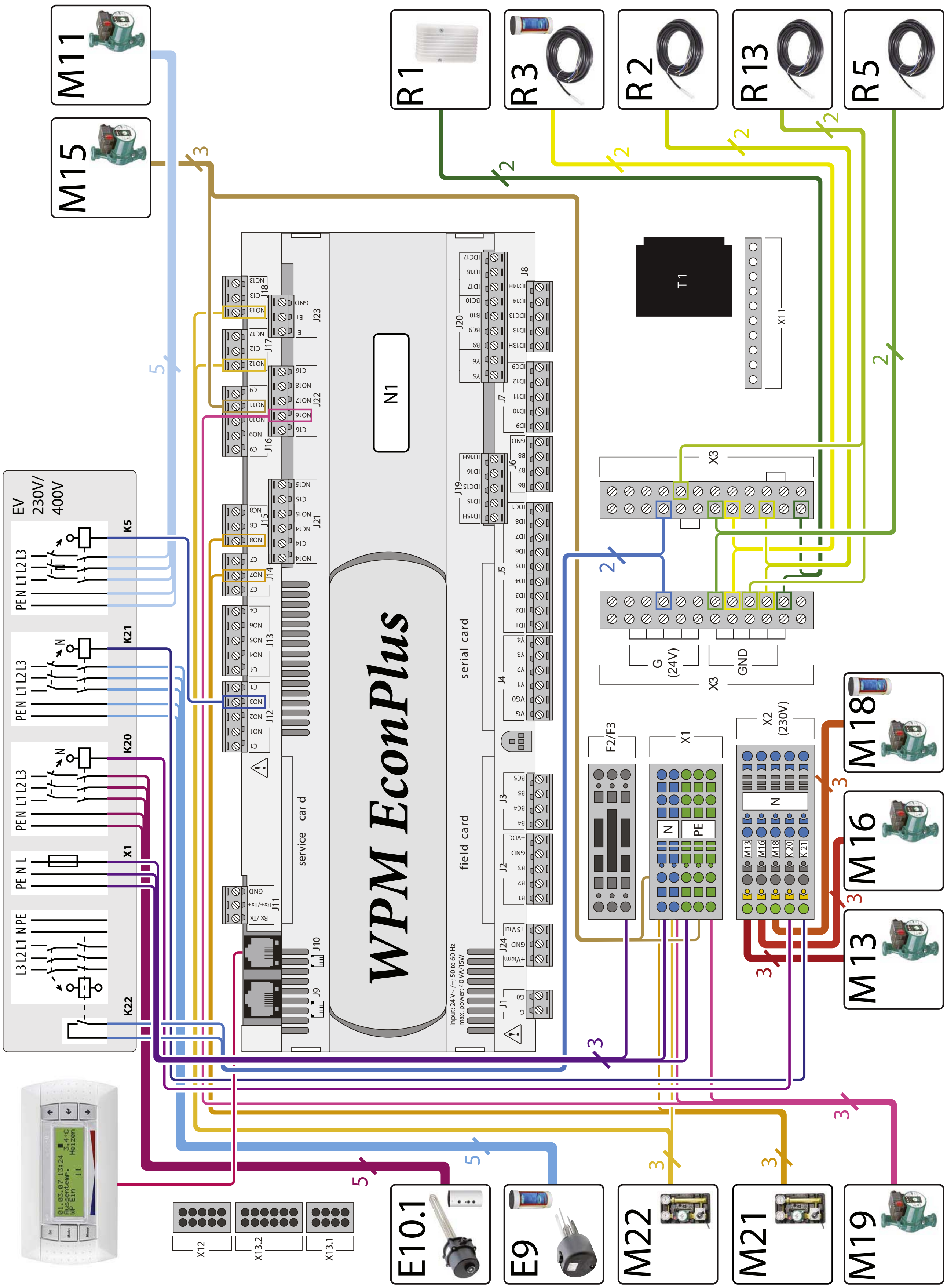


Fig. 7.11: Connection diagram of the wall-mounted heat pump manager WPM 2006 plus (N1 heating controller)

7.6.4 Connection diagram WPM EconPlus



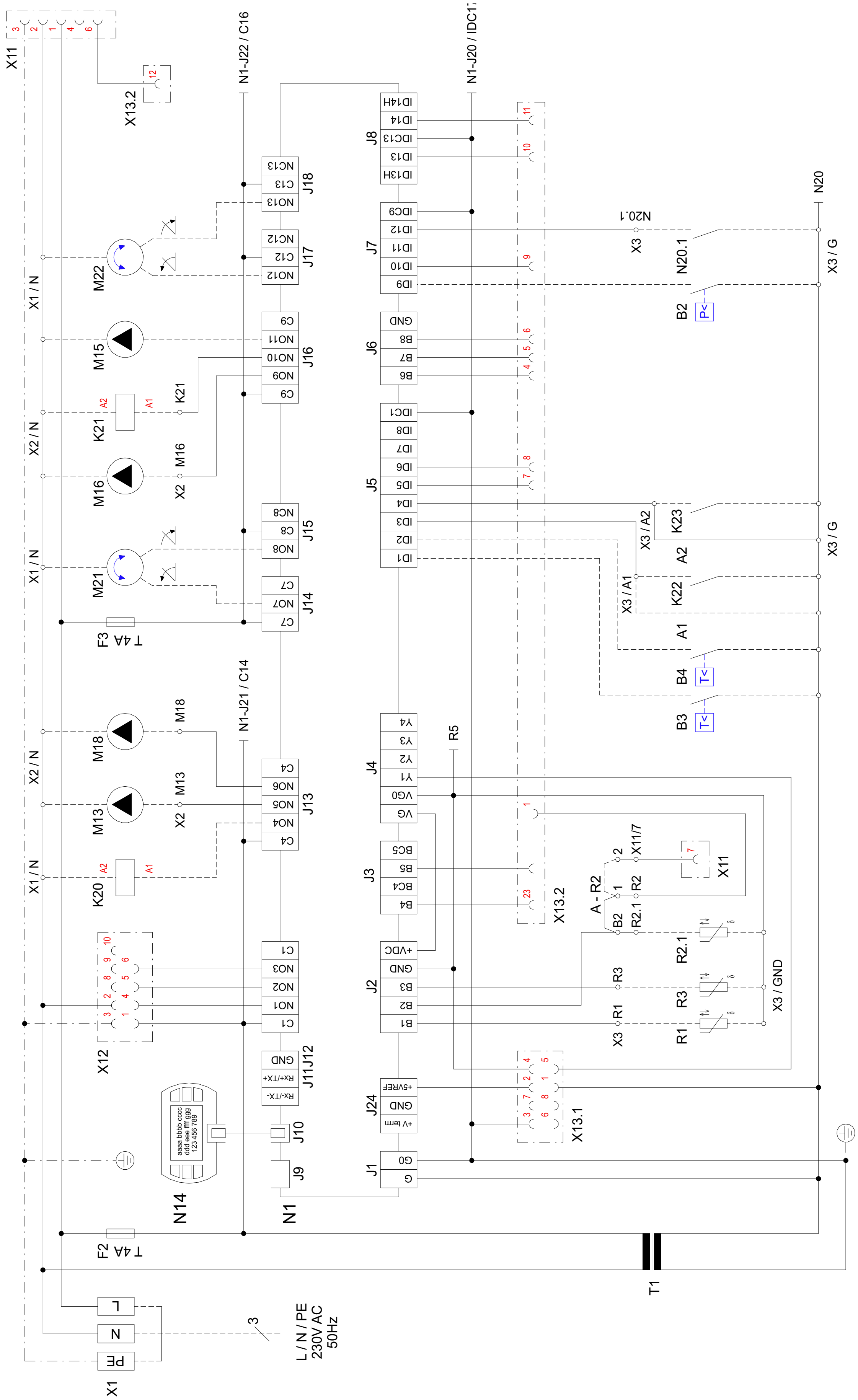


Fig. 7.12: Connection diagram of the wall-mounted heat pump manager WPM EconPlus

7.6.5 Connection diagram WPM EconSol

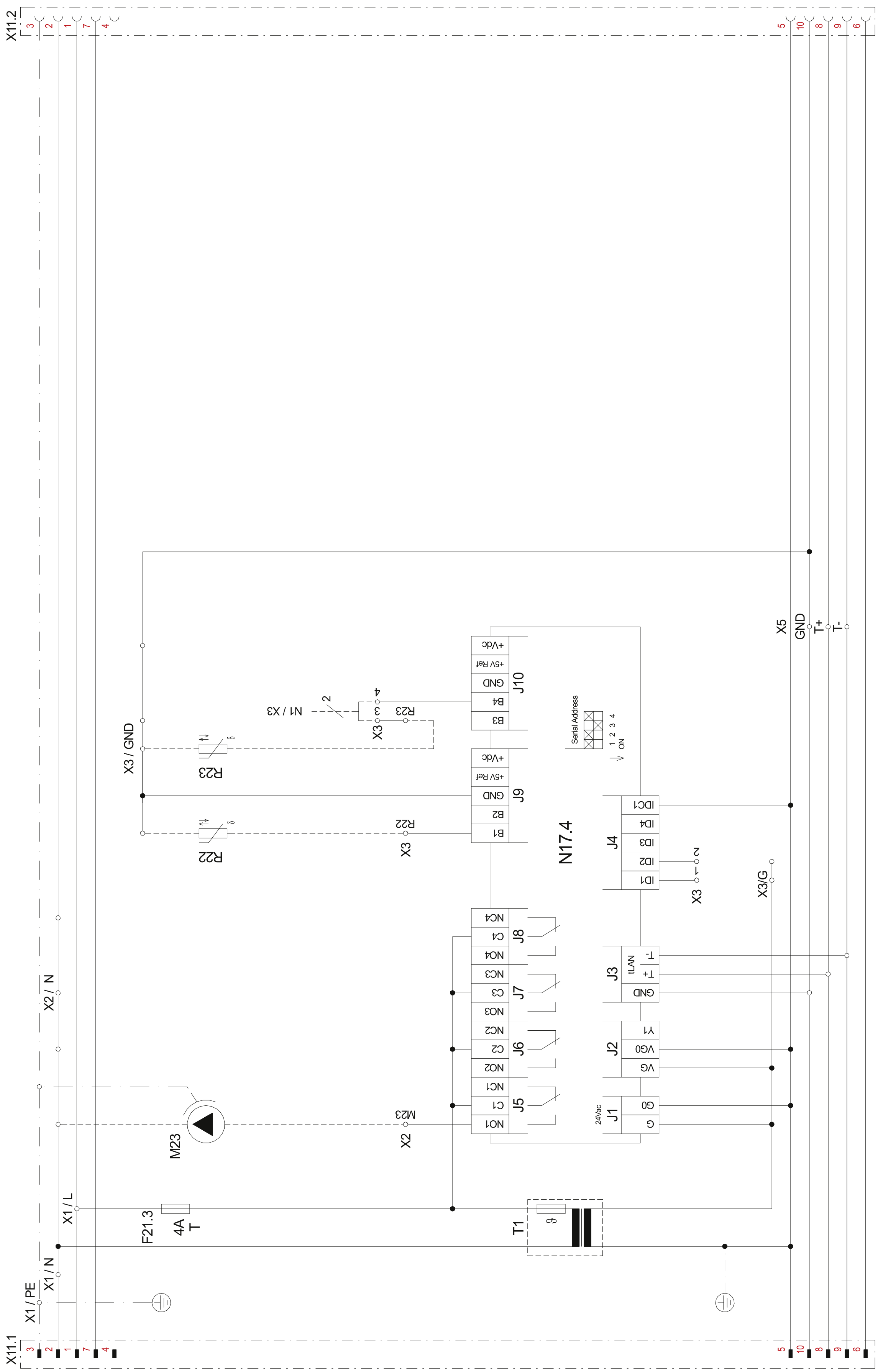


Fig. 7.13: WPM EconSol Connection diagram

7.6.6 Legend for connection diagrams

A	**Link cables**
A1	Link cable: Utility company block (**E**nergie**V**ersoger**S**perre - EVS) - must be installed if the supply voltage is not interrupted by the energy provider
A2	Link cable: Heat pump block - frost protection guaranteed
A3	Link cable for heat pumps without motor protection contact of the primary circulating pump or the fan
A4	Link cable for heat pumps without motor protection contact of the compressor
A5	Link cable, supplementary heating
B	**Auxiliary switch**
B2*	Low pressure switch brine
B3*	Domestic hot water thermostat
B4*	Swimming pool water thermostat
E	**Heating, cooling and auxiliary units**
E3	Defrost end pressure switch
E5	Condensation pressure switch
E9	Flange heater domestic hot water
E10*	2nd heat generator (function selectable via controller)
E13*	2nd chiller
F	**Safety units**
F1	Control fuse of N2 / N6
F2	Load fuse for plug-in terminals J12 and J13 5 x 20 / 4.0 A slow-acting
F3	Load fuse for plug-in terminals J15 to J18, 5 x 20/4.0 A slow-acting
F4	High pressure switch
F5	Low pressure switch
F6	Brine limit protection thermostat
F7	Safety temperature monitor
F10	Flow rate switch (cooling operation)
F21.3	Fuse 5x20 / 4.0 AT
F23	Motor protection M1 / M11
H	**Lamps**
H5*	Remote fault indicator lamp
K	**Contactors, relays, contacts**
K1	Contactor compressor 1
K1.1	Start-up contactor, compressor 1
K1.2	Time relay, compressor 1
K2	Contactor (relay), fan 1
K3	Contactor compressor 2
K3.1	Start-up contactor, compressor 2
K3.2	Time relay, compressor 2
K4	Contactor fan 2
K5	Contactor, primary circulation pump - M11
K6	Contactor, primary circulation pump 2 - M20
K7	Semiconductor relay, defrosting
K8	Contactor / relay supplementary heating
K9	Coupling relay, 230 V / 24 V, for defrost end or brine limit protection
K11*	Electronic relay for remote fault indicator
K12*	Electronic relay for swimming pool water circulating pump
K20*	Contactor for 2nd heat generator
K21*	Contactor, flange heater for domestic hot water
K22*	Utility blocking contactor (EVS)
K23*	Auxiliary relay for block
M	**Motors**
M1	Compressor 1
M2	Fan
M3	Compressor 2
M11*	Primary circulation pump heat source
M13*	Heat circulating pump for main heating circuit 1
M15*	Heat circulating pump heating circuit 2
M16*	Auxiliary circulating pump
M18*	Domestic hot water circulating pump (cylinder charge pump)
M19*	Swimming pool water circulating pump
M20*	Heat circulating pump heating circuit 3
M21*	Mixer for bivalent or heating circuit 3
M22*	Mixer heating circuit 2
M23*	Solar pump
N	**Control elements**
N1	Heating controller
N10*	Remote control
N11*	Relay module
N14	Control panel for WPM 2007
N17.4	"Solar" module (WPM Econ SOL)
Q1	Miniature circuit breaker M11
R	**Sensors, resistors**
R1	Outside temperature sensor
R2	Return temperature sensor
R3*	Domestic hot water temperature sensor
R4	Return temperature cooling water
R5*	Temperature sensor heating circuit 2
R6	Brine limit protection temperature sensor
R7	Coding resistance
R9	Flow temperature sensor (frost protection sensor)
R12	Defrost end temperature sensor
R13	Temperature heating circuit 3 / temperature renewable
R17*	Room temperature sensor
R18	Hot gas temperature sensor
R20	Swimming pool temperature sensor
R22*	Solar cylinder
R23*	Collector sensor
T	**T-Transformer**
T1	Safety transformer 230/24V AC
W	**Cables**
W1	Control cable, 15-pole
W1 - #	Wire number of cable W1 **W1-#8 must always be connected!**
X	**Terminals, manifolds, plugs**
X1	Supply connection terminal strip 230 V (L/N/PE)
X2	Extra-low voltage
X3	Extra-low voltage
X4	Plug connector terminal
X5	Distribution board terminal 0V AC
X8	Control cable plug connector (extra-low voltage)
X11	Module connection plug
Y	**Valves**
Y1	Four-way reversing valve
Y5*	Three-way distribution valve
Y6*	Two-way isolating valve
*	Optional, to be supplied by the customer

7.6.7 Heat pump manager terminal assignment

N1	**Heating controller**
N1-J1	Power supply (24V AC / 50 Hz)
N1-J2-B1	Outside temperature sensor - R1
N1-J2-B2	Return temperature sensor - R2
N1-J2-B3	Domestic hot water temperature sensor - R3
N1-J3-B4	Coding - R7
N1-J3-B5	Flow- or frost protection temperature sensor heating - R9
N1-J4-Y1	Defrosting
N1-J4-Y2	Fault indicator lamp - H5 via K11
N1-J4-Y3	Swimming pool water circulating pump - M19 via K12
N1-J5-ID1	Domestic hot water thermostat - B3
N1-J5-ID2	Swimming pool water thermostat - B4
N1-J5-ID3	Utility company block
N1-J5-ID4	Block
N1-J5-ID5	Fan / primary pump fault - M2 / M11
N1-J5-ID6	Compressor fault - M1 / M3
N1-J5-ID8	Flow rate switch (cooling operation)
N1-J5-ID7	Defrost end pressure switch - E3; brine limit protection - pressure switch - F6
N1-J6-B6	Temperature sensor heating circuit 2/defrost end temperature sensor - R5
N1-J6-B7	Brine limit protection sensor - R6; defrost end sensor - R12
N1-J6-B8	Frost protection sensor, cooling - R8; sensor for heating circuit 3 / renewable sensor - R13
N1-J7-ID9	Low pressure switch brine - B2
N1-J7-ID10	Hot gas thermostat - F7
N1-J7-ID11	Switching protocol TAE
N1-J8-ID13H	High pressure switch - 230V AC - F4
N1-J8-ID13	High pressure switch - 24V AC - F4
N1-J8-ID14	Low pressure switch - 24V AC - F5
N1-J8-ID14H	Low pressure switch - 230V AC - F5
N1-J10	Remote control - N10 / control panel - N14
N1-J11	Connection for pLAN
N1-J12-NO1	Compressor 1 - M1
N1-J13-NO2	Compressor 2 - M3
N1-J13-NO3	Primary circulation pump - M11 / fan - M2
N1-J13-NO4	2nd heat generator (E10)
N1-J13-NO5	Heat circulating pump - M13
N1-J13-NO6	Domestic hot water circulating pump - M18
N1-J14/J15-NO7/N08	Mixer open/closed - heating circuit 3 - M21
N1-J16-NO9	Auxiliary circulating pump - M16
N1-J16-NO10	Flange heater domestic hot water - E9
N1-J16-NO11	Heat circulating pump of heating circuit 2 - M15
N1-J17/J18-NO12/NO13	Mixer open/closed - heating circuit 2 - M22
N1-J20-B9	

N17.4	**"Solar" module (WPM Econ SOL)**
N17.1-J5-NO1	Solar circulating pump - M23
N17.1-J9-B1	Solar cylinder sensor - R22
N17.1-J10-B4	Collector sensor - R23
*	Optional, to be supplied by the customer

7.7 Connection of external system components to the heat pump manager

Inputs

Connection			Explanation
J2-B1	X3-R1*	X3	External sensor
J2-B2	R2.1*	X3	Return sensor
J2-B3	R3*	X3	Domestic hot water sensor
J3-B5		X3	Flow sensor (antifreeze)
J6-B6	X3-R5*	J6-GND	Sensor, heating circuit 2
J6-B8	X3-R13*	J6-GND	Sensor, heating circuit 3
J5-ID1		X2	Domestic hot water thermostat
J5-ID2		X2	Swimming pool thermostat
J5-ID3		X2	Utility block
J5-ID4		X2	External disable contact
J5-ID5		X2	Primary pump / fan fault
J5-ID6		X2	Compressor fault
J7-ID9		X2	Low pressure brine
J7-ID12	X3-N20.1	X3	External thermal energy meter 1
J20-ID17		X3	Circulation system requirements
J20-ID18	X3-N20.1	X3	External thermal energy meter 2

* EconPlus

Outputs

Connection			Explanation
J12-NO3		N / PE	Primary pump / fan
J13-NO4		N / PE	2nd heat generator
J13-NO5	X2-M13*	N / PE	Heat circulating pump
J13-NO6	M18*	N / PE	Domestic hot water circulating pump
J14-NO7		N / PE	Mixer open
J15-NO8		N / PE	Mixer closed
J16-NO9	X2-M16*	N / PE	Auxiliary circulating pump
J16-NO10	K21*	N / PE	Flange heater domestic hot water
J16-NO11		N / PE	Heat circulating pump for heating circuit 2
J17-NO12		N / PE	Mixer open - heating circuit 2
J18-NO13		N / PE	Mixer closed - heating circuit 2
J4-Y2	J22-NO17*	X2	Remote fault indicator
J4-Y3	J22-NO16*		Swimming pool circulating pump
-	J22-N018		Circulation pump

i NOTE

With the WPM 2006 plus, the remote fault indicator and the swimming pool pump are connected via the RBG WPM relay module which is available as a special accessory.

7.8 Technical data for the heat pump manager

Line voltage		230 V AC 50 Hz
Voltage range		195 to 253V AC
Power consumption		Approx. 14 VA
Degree of protection according to EN 60529; protection class according to EN 60730		IP 20
Switching capacity of outputs		Max. 2 A (2 A) cos (φ) = 0.4 at 230 V
Operating temperature		0 °C to 35 °C
Storage temperature		-15 °C to +60 °C
Weight		4,100 g
Party setting range	Standard time	0 – 72 hours
Vacation setting range	Standard time	0 – 150 days
Temperature measuring ranges	External wall temperature	-20 °C to +80 °C
	Return temperature	-20 °C to +80 °C
	Frost protection sensor (flow temperature)	-20 °C to +80 °C
Heating controller setting ranges	Limit temperature boiler release	-20 °C to +20 °C
	Maximum return temperature	+20 °C to +70 °C
	Warmer/colder	+5 °C to +35 °C
	Hysteresis/neutral zone	+0.5 °C to +5.0 °C
Setting range Lower operation / raise operation	Warmer/colder	+5 °C to +35 °C
Setting range Domestic hot water basic temperature	Set temperature	+30 °C to +55 °C
Setting range Domestic hot water reheating	Set temperature	+30 °C to +80 °C
Mixer setting range	Mixer runtime	1-6 minutes

Compliance with utility requirements

- Switch-on delay when supply voltage is recovered or utility shut-off time is lifted (10 s to 200 s)
- The heat pump compressors are switched on a maximum of three times per hour.
- Heat pump is switched off by the utility blocking signal with the option of switching on the second heat generator .

General

- Self-adjusting defrosting cycle time
- Monitoring and fusing equipment of the refrigerating cycle according to DIN 8901 and DIN EN 378
- Identification of the respective optimum mode of operation with the largest possible heat pump proportion
- Frost protection function

Low pressure switch brine for installation in the brine circuit (special accessory)

i NOTE

WPM EconPlus

Integrated thermal energy metering with sensors in the refrigerating circuit

7.9 WPM Master for connecting multiple heat pumps in parallel

7.9.1 Description WPM Master

The wall-mounted WPM Master is available for controlling up to 14 heat pumps in parallel. With this controller, up to 30 performance levels of a monovalent, mono energy or bivalent system can be controlled with outside-temperature dependant mode switching.

Fig. 7.14: Controller for parallel connection of heat pumps - WPM Master

The WPM Master offers convenient 6-button operation. The status values are output via an LC display with clear text (4x 20 characters).

NOTE

The contrast of the display can be brightened with the key combination (ESC), (MODUS), and (⇧) or darkened with (ESC), (MODUS), and (⇩) All three keys must be pressed and held together until the required contrast level is set.

Functional description

- Parallel connection of up to 14 heat pumps
- Maximum of 30 performance levels
  (passive cooling, 28 compressors, 2nd heat generator)
- Control of max. 3 heating circuits
- Central switching of operating modes
- Combination of passive and active cooling
- Automatic mode switching via limit temperatures
  (Automatic, Summer, Cooling)
- Same as heat pumps with two performance levels
- Adjustable time window
- Adjustable switch-on times

Central and decentral control

Central or decentral domestic hot water preparation can be used when controlling multiple heat pumps.

Central control

- Central definition of priorities for domestic hot water, heating, cooling and swimming pool
- Requirements are processed individually
- Definition of maximum performance levels for domestic hot water preparation
- Decentral evaluation of a heat pump fault

Decentral control

- Central definition of priorities for heating and cooling
- Decentral definition of priorities for domestic hot water and swimming pool
- Parallel operation of heating /cooling and domestic hot water preparation/swimming pool possible

Definition of priorities

In order to ensure that the entire system operates efficiently, the heat pumps are activated with different priorities by the master controller. The master controller receives feedback from the individual heat pump managers and therefore detects a fault or decentral request for blocked heat pumps. With combinations of different heat pump types (air-to-water and brine-to-water heat pumps), the different heat pumps are activated according to the outside temperature:

- Preference is given to air-to-water heat pumps above an adjustable outside temperature
- Preference is given to brine-to-water heat pumps below an adjustable outside temperature

In order to achieve a runtime distribution that is as even as possible, the master controller starts the compressor with the lowest runtime first of all. To this end, the master controller determines the runtimes of the individual compressors.

7.9.2 Electrical connection WPM Master

1) The three-core **supply cable** for the **heat pump manager** (N1 heating controller) is fed into the heat pump (device with integrated controller) or to the future mounting location of the heat pump manager (WPM). The (L/N/PE~230 V, 50 Hz) supply cable for the heat pump manager must have a constant voltage. For this reason, it should be tapped upstream from the utility blocking contactor or be connected to the household current, as important protection functions may otherwise be lost during a utility block.
2) The **contactor** (K20) for the **immersion heater** (E10) of mono energy systems (HG2) should be dimensioned according to the radiator output and **must be supplied by the customer**. It is controlled (230V AC) by the heat pump manager via terminals X1/N and N1-J13/NO 4.
3) The **contactor** (K21) for the **flange heater** (E9) in the domestic hot water cylinder should be dimensioned according to the radiator output and **must be supplied by the customer**. It is controlled (230V AC) by the heat pump manager via terminals X2/N and N1-X2/K21.
4) The contactors mentioned in points 3, 4 and 5 are installed in the electrical distribution system. The mains cables for the heating elements should be dimensioned and protected according to DIN VDE 0100.
5) The **heat circulating pump** (M13) is connected to terminals X2/N and N1-X2/M13.
6) The **domestic hot water circulating pump** (M18) is connected to terminals X2/N and N1-X2/M18.
7) The return sensor is integrated into air-to-water heat pumps for outdoor installation, and is connected to the heat pump manager via the control cable. The return sensor must be installed in the immersion sleeve in the manifold only when a dual differential pressureless manifold is used. The single-core wires are then connected to terminals X3/GND and X3/R2.1. The A-R2 link cable (which is situated between X3/B2 and X3/1 when delivered) must then be connected to the X3/1 and X3/2 terminals.
8) The **external sensor** (R1) is connected to terminals X3/GND (ground) and N1-X3/R1.
9) The **domestic hot water sensor** (R3) is installed in the domestic hot water cylinder and is connected to terminals X3/GND (ground) and N1-X3/R3.

NOTE

When using three-phase current pumps, a power contactor can be activated with the 230V output signal of the heat pump manager.
Sensor cables can be extended with 2 x 0.75 mm cables up to 40 m.

7.9.3 Configuration of the network

The network is a bus system which is connected via terminal J11 (both to the heat pump manager and the master controller). A maximum of 32 participants can be present in the network (16 controllers and 16 control panels).

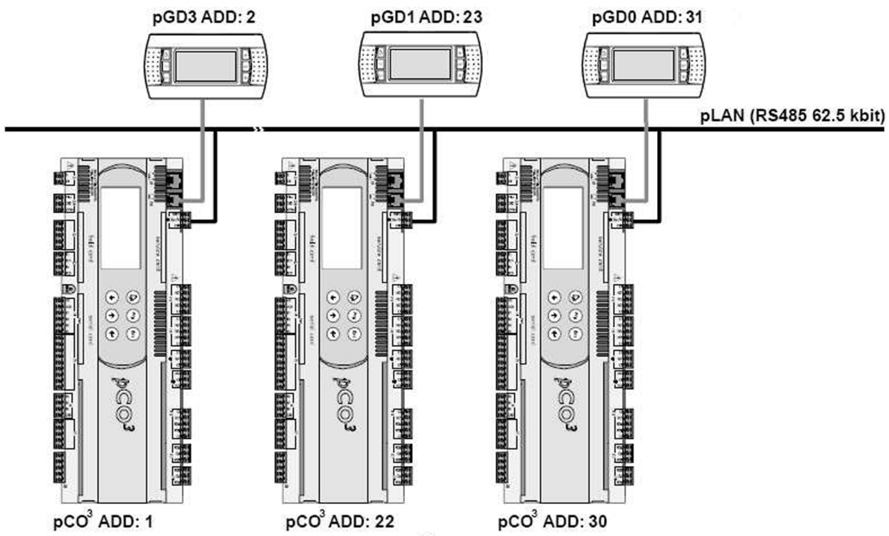


Fig. 7.15: Example of a possible network, including three heat pump managers with three control panels (pGD)

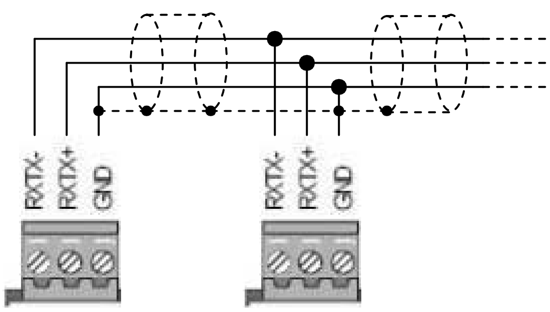


Fig. 7.16: View of the connection on terminal J11 of the heat pump manager

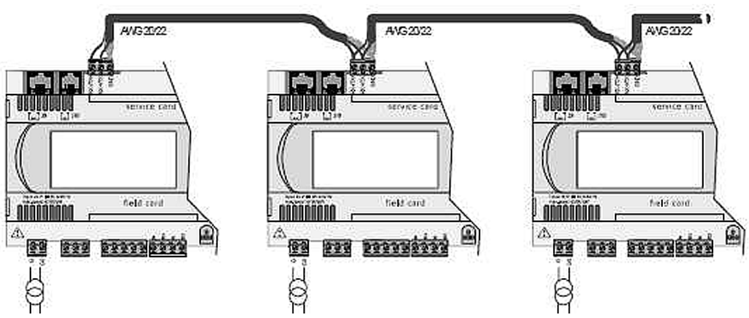


Fig. 7.17: Three heat pump managers, each with their own power supply

NOTE

It is recommended to use a twisted, shielded cable AWG20/22 (0.75/0.34 mm²) as a connecting cable. The network must not exceed a maximum length of 500 m. The cable must have a maximum capacitance of 90 pF/m.

8 Integration of the heat pump in the heating system

8.1 Hydraulic requirements

During the hydraulic integration of a heat pump, it must be kept in mind that the heat pump only has to generate the actual required temperature level to increase efficiency. The objective is to feed the temperature level generated by the heat pump directly (unmixed) into the heating system.

NOTE

A mixed heating circuit only becomes necessary when two different temperature levels have to be supplied (e.g. for underfloor and radiator heating systems).

To prevent a mixing of the different temperature levels, the heating operation is stopped during a domestic hot water demand and the heat pump is operated with the higher flow temperatures necessary for domestic hot water preparation.

The following basic requirements must be fulfilled:

- Guarantee frost protection Chapt. 8.2 on page 94
- Safeguard the heating water flow rate Chapt. 8.3 on page 95
- Ensure the minimum runtime

Living comfort must still be ensured when setting the setpoint/heating curve, but the setpoint/heating curve should not be set higher than absolutely necessary.

NOTE

For each Kelvin increase in the flow temperature, the efficiency of the heat pump heating system reduces by 2.5 %.

In order to keep the flow temperature for the heating of a building as low as possible, the heating distribution system must be dimensioned for the flow temperature. The following examples are suitable for operation with low flow temperatures:

- Underfloor heating
- Concrete core activation
- Fan convectors
- Radiant ceiling panels
- Ventilation register with extended heat exchanger area

NOTE

In buildings with low flow temperatures, additional electric radiators should be included in the bathroom. The low flow temperatures alone are not usually sufficient to dry hand towels adequately. It is also not advisable to use a heating cartridge in a radiator filled with water.

8.2 Guarantee frost protection

If a heat pump is positioned outside or if outside air flows through the heat pump, measures must be taken to prevent a freezing of the heating water during standstill periods or faults.

If a minimum temperature on the frost protection sensor (flow sensor) of the heat pump is not reached, the heating- and auxiliary circulating pumps are activated automatically to ensure that the frost protection is maintained. In mono energy or bivalent systems, the second heat generator is released in case of heat pump faults.

ATTENTION!

In heating systems with utility company shut-off times, the supply cable for the heat pump manager must be supplied with constant voltage (L/N/PE~230 V, 50 Hz). For this reason, it should be tapped upstream from the utility blocking contactor or be connected to the household current.

The heating circuit should be operated with a suitable antifreeze if heat pump systems are implemented in buildings where a power failure can not be detected (e.g. holiday home).

ATTENTION!

If the heat pump is operated with a water/glycol mixture with a glycol portion of 25%, the efficiency during heating and cooling is reduced by approx. 15%.

In constantly occupied buildings the use of antifreeze in the heating water is not recommended since the frost protection is ensured to the greatest possible extent through the heat pump controller and an antifreeze reduces the efficiency of the heat pump.

A method of manual drainage should be provided for heat pumps which are exposed to frost. The system should be drained at three locations, and if required, blown out whenever it is taken out of service or in the event of a power failure.

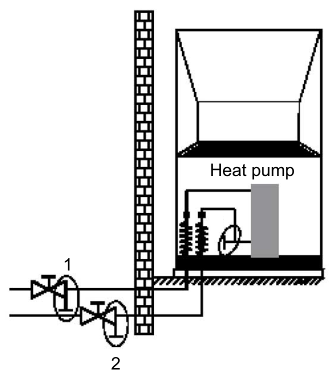


Fig. 8.1: Circuit diagram for installation of a heat pump exposed to frost

ATTENTION!

The hydraulic integration must be carried out in such a way that the flow is maintained through the heat pump - and thus the integrated sensors - at all times even in case of a special integration or bivalent operation.

8.3 Safeguard the heating water flow rate

The minimum heating water flow rate listed in the device information must be maintained for all operating states to guarantee the functional operation of the heat pump. The circulating pump should be dimensioned so that the water flow through the heat pump is also maintained even if there is a maximum pressure drop in the system (almost all heating circuits closed).

The required temperature spread can be determined in two possible ways:

- Arithmetical calculation Chapt. 8.3.1 on page 95
- Reading out of tabular values in relation to the heat source temperature Chapt. 8.3.2 on page 95

A number of different points must be taken into account when defining the heating water flow rate in the heat pump generator circuit. The minimum heating water flow rate must be guaranteed in all operating situations. With controlled pumps, it is particularly important to ensure that the pump is set to a constant speed (e.g. Grundfos Alpha 2) and that the internal control functions of the pump do not result in a brief fall in the volume flow (e.g. pump standstill due to ventilation function during air bubble detection).

With lower flow temperature, a higher volume flow is desirable, which is dependant on the system and the heat pump used. The following spreads are recommended in the in the design point:

- 35°C: approx. 5 K spread, but never below minimum heating water flow rate
- 45°C: approx. 7 K spread, but never below minimum heating water flow rate
- 55°C: max. 10 K spread, but never below minimum heating water flow rate
- 65°C: max. 10 K spread, but never below minimum heating water flow rate

On systems with extremely low system temperatures (flow temperatures ≤ 25°C) a max. spread of 5 K must be specified in the design point during planning. Systems for heating and cooling must be designed for the highest required water flow (heating water or cooling water throughput).

8.3.1 Arithmetic calculation of the temperature spread

- Determination of the current heat output of the heat pump from the heat output curves at the average heat source temperature.
- Calculation of the required temperature spread using the minimum heating water flow rate listed in the device information.

i NOTE

Tabular values for the required temperature spread in relation to the heat source temperature can be found in Chapt. 8.3.2 on page 95.

Example: air-to-water heat pump:

Heat output $\dot{Q}_{HP}$ = 10.9 kW at A10/W35

Specific heat capacity of water: 1.163 Wh/kg K

Required minimum heating water flow rate:

e.g. V = 1,000 l/h = 1,000 kg/h

Required spread:

$$\Delta T = \frac{10900\ W\ kg\ K\ h}{1{,}163\ Wh \cdot 1000\ kg} = 9{,}4\ K$$

8.3.2 Temperature spread in relation to the heat source temperature

The heat output of the heat pump depends on the heat source temperature. With the heat source external air in particular, the heat output generated by the heat pump depends heavily on the current heat source temperature.

The maximum temperature spread in relation to the heat source temperature can be found in the following tables.

Air-to-water heat pump,

Heat source temperature		Max. temperature spread between heating flow and return	
of	to	2 Compressor	1 Compressor
-20 °C	-15 °C	2K	4K
-14 °C	-10 °C	2.5K	5K
-9 °C	-5 °C	3K	6K
-4 °C	0° C	3.5K	7K
1 °C	5 °C	4K	8K
6 °C	10 °C	4.5K	9K
11 °C	15 °C	5K	10K
16 °C	20 °C	5.5K	11K
21 °C	25 °C	6K	12K
26 °C	30 °C	6.5K	13K
31 °C	35 °C	7K	14K

Table 8.1: Outside air heat source (temperature can be read from the heat pump manager!), operation with 1 compressor

Brine-to-water heat pump

Heat source temperature		Max. temperature spread between heating flow and return
of	to	
-5° C	0 °C	10K
1 °C	5 °C	11K
6 °C	9 °C	12K
10 °C	14 °C	13K
15 °C	20 °C	14K
21 °C	25 °C	15K

Table 8.2: Heat source: Ground, operation with 1 compressor

Water-to-water heat pump

Heat source temperature		Max. temperature spread between heating flow and return
of	to	
7° C	12 °C	10K
13 °C	18 °C	11K
19 °C	25 °C	12K

Table 8.3: Heat source: Ground water, operation with 1 compressor

8.3.3 Overflow valve

In the case of systems with only one heating circuit and even volume flows in the consumer circuit, the main circuit (M13) heat circulating pump can also be used to maintain the flow through the heat pump and the heating system (see Fig. 8.39 on page 119).

If room temperature controllers are used, the radiator valves and thermostat valves could cause the volume flows in the consumer circuit to fluctuate. These volume flow fluctuations must be compensated for by an overflow valve installed in the heating bypass downstream from the unregulated heating pump main circuit (M13).

If there is an increasing drop in pressure in the consumer circuit (for example because valves are in the process of being closed) a partial volume flow is directed through the heating bypass, thus ensuring a minimum heating water flow rate through the heat pump.

i NOTE

Electronically regulated circulating pumps which reduce the volume flow with increasing drops in pressure should not be used in combination with an overflow valve.

Overflow valve adjustment

- Close all of the heating circuits that may also be closed during operation (depending on usage) so that the most unfavourable operating state - with respect to the water flow - is achieved. This normally means the heating circuits of the rooms on the south and west sides of the building. At least one heating circuit must remain open (e.g. bathroom).
- The overflow valve should be opened far enough to produce the maximum temperature spread between the heating flow and return listed in Chapt. 8.3.2 on page 95 for the current heat source temperature. The temperature spread should be measured as close as possible to the heat pump.

i NOTE

If the overflow valve is closed too far, the minimum heating water flow rate through the heat pump is not guaranteed.
If the overflow valve is opened too far, individual heating circuits may no longer have a sufficient flow.

8.3.4 Differential pressureless manifold

The minimum heating water flow rate is maintained by the heat pump under all operating statuses through the hydraulic isolation of the generator circuit from the consumer circuit (see Fig. 8.40 on page 119).

The installation of a differential pressureless manifold is recommended for:

- Heating systems with radiators
- Heating systems with more than one heating circuit
- Unknown pressure drops in the consumer circuit (e.g. in existing buildings)

The main circuit (M13) heat circulating pump ensures the minimum heating water flow rate of the heat pump for all operating states without the need for manual settings.

Different volume flows in the heat generator and consumer circuits are balanced via the differential pressureless manifold. The pipe cross section of the differential pressureless manifold should have the same diameter as the heating system flow and return.

i NOTE

The maximum flow temperature of the heat pump in the heating circuits will not be reached if the volume flow in the consumer circuit is higher than the the volume flow in the generator circuit.

8.3.5 Dual differential pressureless manifold

In a heat pump, the dual differential pressureless manifold is a useful alternative to the buffer tank connected in parallel, since it fulfills the same function without compromising when it comes to efficiency. The hydraulic isolation is realised using two manifolds without differential pressure with a check valve each (see Fig. 8.41 on page 120).

Advantages of the dual manifold without differential pressure:

- Hydraulic isolation of the generator circuit and the consumer circuit
- Operation of the circulating pump (M16) in the generator circuit with the compressor in heating operation only, to avoid unnecessary operation
- Possibility for a joint use of the buffer tank connected in series by the heat pump and the additional heat generator
- Protection of the heat pump against too high temperatures when external energy is fed into the buffer tank connected in series
- Guarantee of the minimum compressor runtimes and defrosting in all possible operating conditions through full circulation of the buffer tank connected in series
- Interruption of the heating operation for the domestic hot water and swimming pool water preparation so that the heat pump is always operated with the lowest possible temperature level.

i NOTE

The hydraulic integration via a dual differential pressureless manifold offers maximum flexibility, operational safety and efficiency.

8.4 Domestic hot water distribution system

The domestic hot water distribution system consists of perfectly matched individual components which can be combined according to individual requirements. The maximum permissible heating water flow rate of each component must be taken into account during the dimensioning.

Connecting the buffer tank and ensuring the heating water flow rate

- Compact manifold
  KPV 25 (recommended up to 1.3 m^3/h)
- Extension module for the manifold without differential pressure EB KPV (recommended for up to 2.0 m^3/h)
- Dual differential pressureless manifold
  DDV 25 (recommended up to 2.0 m^3/h)
  DDV 32 (recommended up to 2.5 m^3/h)
  DDV 50 (recommended up to 7.5 m^3/h)

Heating distribution system modules

- Unmixed heating circuit module
  WWM 25 (recommended up to 2.5 m^3/h)
  WWM 50 (recommended up to 8.0 m^3/h)
- Mixed heating circuit module
  MMH 25 (recommended up to 2.0 m^3/h)
  MMH 50 (recommended up to 8.0 m^3/h)
- Manifold bar for connecting two heating circuits
  VTB 25 (recommended up to 2.5 m^3/h)

Domestic hot water preparation distribution system modules

- Domestic hot water module
  WWM 25 (recommended up to 2.5 m^3/h)

Manifold bar for connecting KPV 25 and WWM 25

VTB 25 (recommended up to 2.5 m^3/h)

- Domestic hot water pump assembly WPG 25 or 32 for direct connection of the domestic hot water circulating pump on the domestic hot water cylinder (see Fig. 8.36 on page 117)

Extension modules for the distribution system

- Mixer module for bivalent systems
  MMB 25 (recommended for up to 2.0 m^3/h)
- Solar station for domestic hot water
  SST 25

i NOTE

The components of the domestic hot water distribution system are shown in the integration diagrams in Chapt. 8.14 on page 112dashed lines.

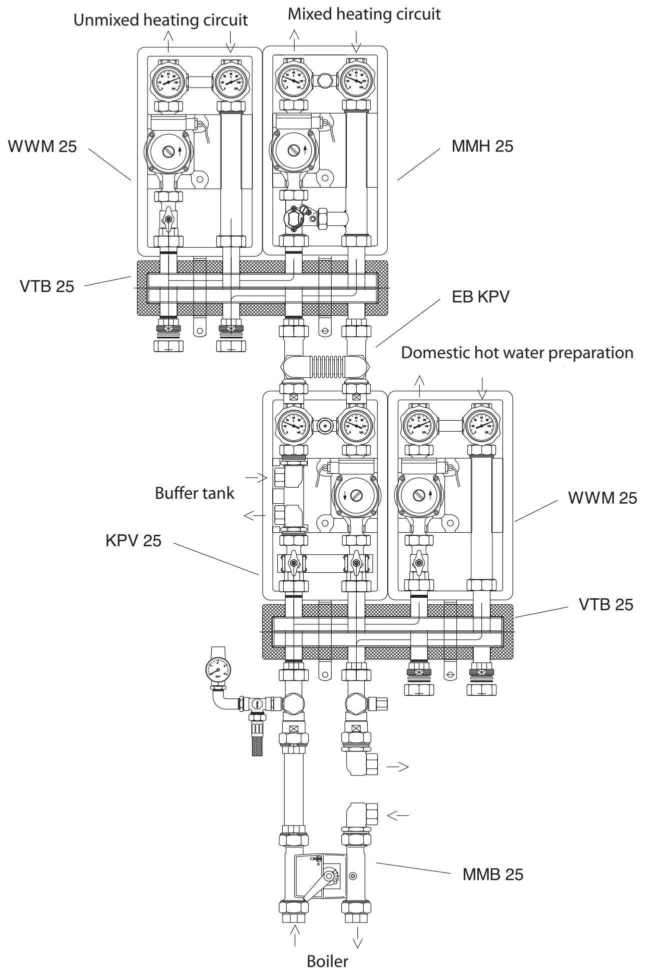


Fig. 8.2: Combination possibilities for the domestic hot water distribution system

The following diagrams show the pressure drop for the individual components:

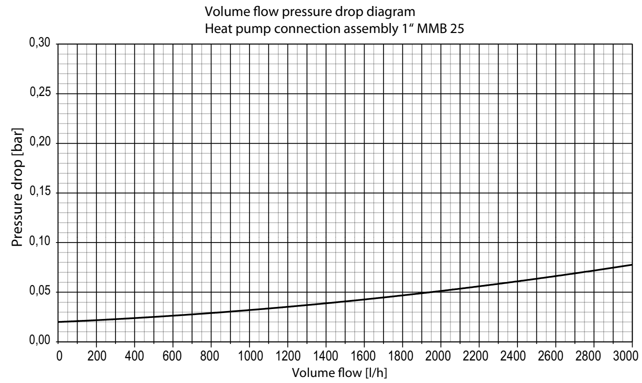


Fig. 8.3: Diagram pressure drops MMB 25

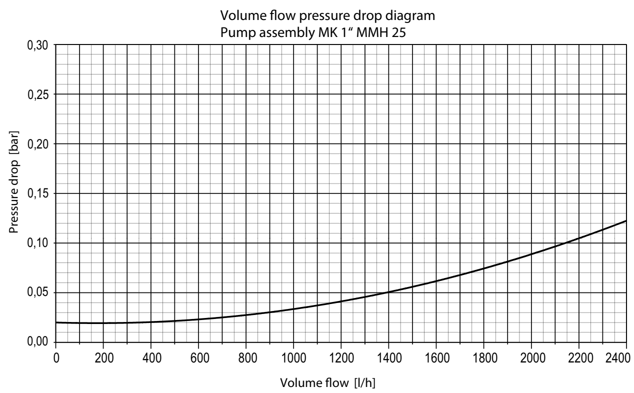


Fig. 8.4: Diagram pressure drop MMH 25

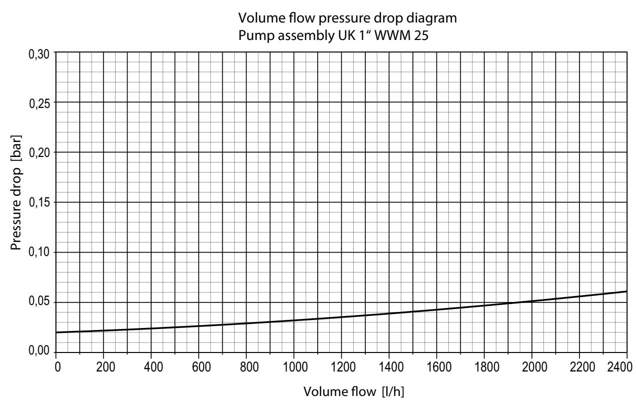


Fig. 8.5: Diagram pressure drop WWM 25

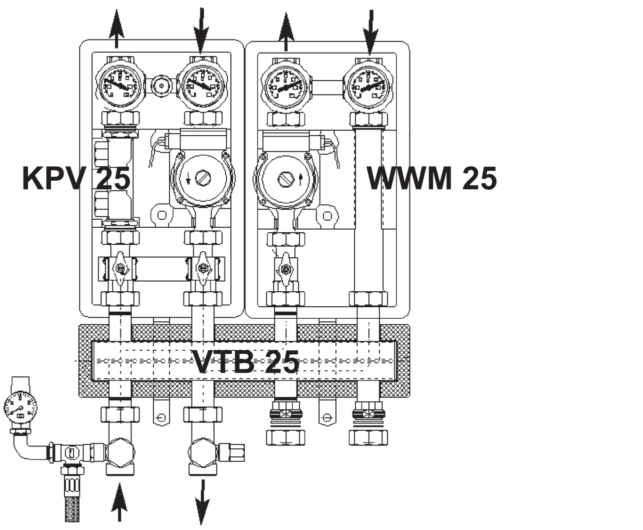
8.4.1 Compact manifold KPV 25

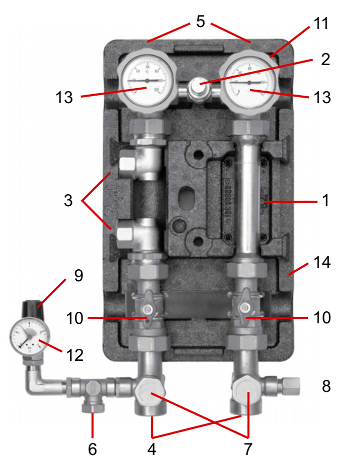
The compact manifold functions like an interface between the heat pump, the heating distribution system, the buffer tank and, in some cases, even the domestic hot water cylinder.

A compact system is used to simplify the installation process, so that a lot of different components do not have to be installed individually.

i NOTE

The use of the compact manifold KPV 25 with overflow valve is recommended for heating systems with panel heating and a heating water flow rate up to max. 1.3 m³/h.





1	Mounting position of heat circulating pump (not included in scope of supply)
2	Overflow valve
3	Buffer tank connections 1” internal thread
4	Heat pump connections 1” internal thread
5	Heating connections 1” internal thread
6	Expansion vessel connection ¾” external thread
7	Domestic hot water heating connections 1” external thread
8	Immersion sleeve for return sensor incl. plastic retainer
9	Safety valve ¾” internal thread
10	Stop-cocks
11	Stop-cock with check valve
12	Thermometer
13	Shell insulation

Fig. 8.6: Compact manifold KPV 25 with manifold bar VTB 25 and domestic hot water module WWM 25

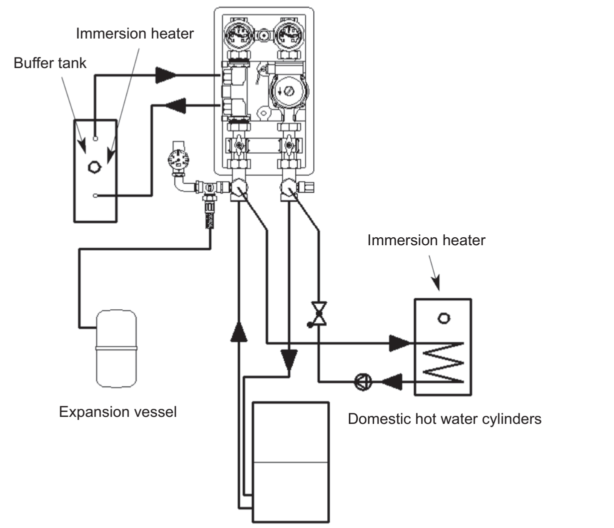


Fig. 8.7: Integration of the compact manifold for heating operation and domestic hot water preparation

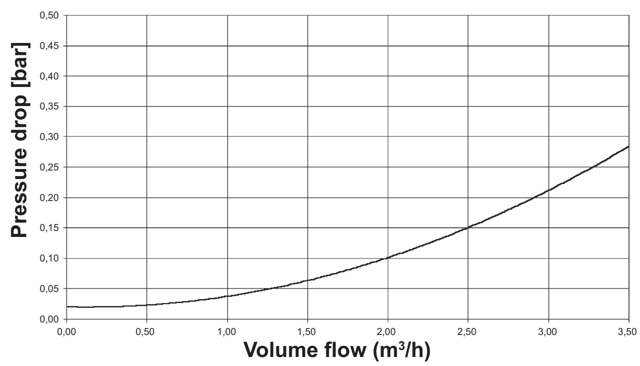


Fig. 8.8: Pressure drop KPV 25 depending on the volume flow

8.4.2 Compact manifold KPV 25 with extension module EB KPV

The compact manifold KPV 25 can be turned into a differential pressureless manifold through the use of the extension module EB KPV. The generator and consumer circuits are hydraulically isolated and they each contain a circulating pump.

NOTE

The use of the compact manifold KPV 25 with extension module EB KPV is recommended for heat pumps with a heating water flow rate up to max. 2.0 m³/h.

8.4.3 Dual differential pressureless manifold DDV

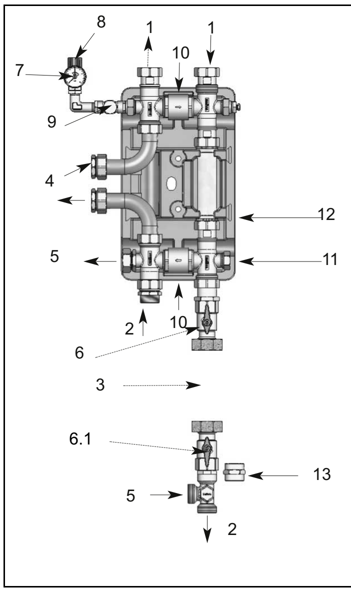
The dual differential pressureless manifold (DDV) functions as an interface between the heat pump, the heating distribution system, the buffer tank and, in some cases, the domestic hot water cylinder.

A compact system is used to simplify the installation process, so that a lot of different components do not have to be installed individually.

Three different versions of the dual differential pressureless manifold are available as accessories:

- DDV 25 (recommended up to 2.0 m³/h)
- DDV 32 (recommended up to 2.5 m³/h)
- DDV 50 (recommended up to 7.5 m³/h)

8.4.3.1 Dual differential pressureless manifold DDV 25 and DDV 32



1	Heating connections 1 1/2" internal thread
2	Heat pump connections 1 1/4" external thread
4	Buffer tank connections 1 1/4" internal thread
5	Domestic hot water cylinder connections 1 1/4" external thread
7	Pressure gauge
8	Safety valve 3/4" internal thread
9	T-joint for mounting the expansion vessel
10	Check valve
11	Immersion sleeve for Return sensor
12	Insulation

Fig. 8.9: Dual differential pressureless manifold (DDV) for the connection of a mixed heating circuit, external supplementary heating and optional domestic hot water preparation.

	DDV 25	DDV 32
3	**Auxiliary circulating pump/ main circuit heat circulating pump 1" external thread**	**Auxiliary circulating pump/ main circuit heat circulating pump 1 1/4" external thread**
6	**Isolation valve 1"**	**Isolation valve 1 1/4"**
6.1	**Isolation valve 1" with check valve**	**Isolation valve 1 1/4" with check valve**
13	**Double nipples 1"**	**Double nipples 1 1/4"**
	Maximum installation length with pump (inside micrometer 180) 96cm	**Maximum installation length with pump (inside micrometer 180) 98cm**

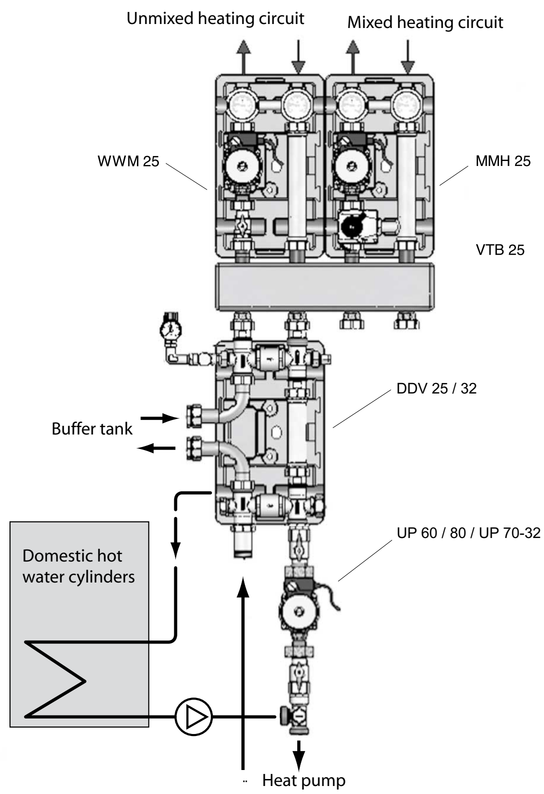


Fig. 8.10: Integration of the dual differential pressureless manifold for heating operation and domestic hot water preparation

NOTE

The installation length of the DDV is approx. 1m incl. pumps!

NOTE

The DDV 25 and DDV 32 are included as accessories with NTC-2 (for WPM 2004 and WPM 2006plus) and NTC-10 (for WPM 200 and WPM Econ Plus) return temperature sensors.

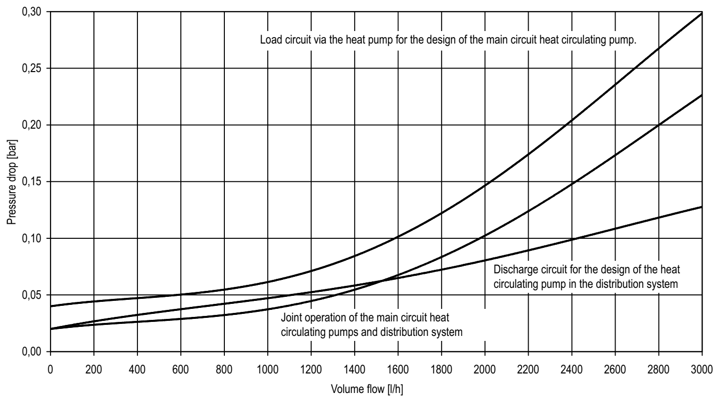


Fig. 8.11: Volume flow/pressure drop diagram DDV 25/32

8.4.3.2 DDV 50 dual differential pressureless manifold

Just like the dual differential pressureless manifolds DDV 25 and DDV 32, the DDV 50 acts as an interface between the heat pump, buffer tank and heating distribution system. Designed for a maximum volume flow of 8.0 m³/h, the DDV 50 is particularly suited to large system technology. The DDV 50 can be combined with two distribution modules, the WWM 50 for an unmixed heating circuit and the MMH 50 for a mixed heating circuit.

Unmixed heating circuit module WWM 50

Pre-assembled module (nominal width DN 50) with insulation shells for connecting an unmixed heating circuit, domestic hot water preparation or swimming pool preparation. Can be used up to a maximum heating water flow rate of 8.0 m³/h. The module offers space for a circulating pump with a pump dimension of 280 mm (with flange and compensation piece) with a nominal width DN 32 and a spacing of 180 mm.

Fig. 8.12: Design WWM 50

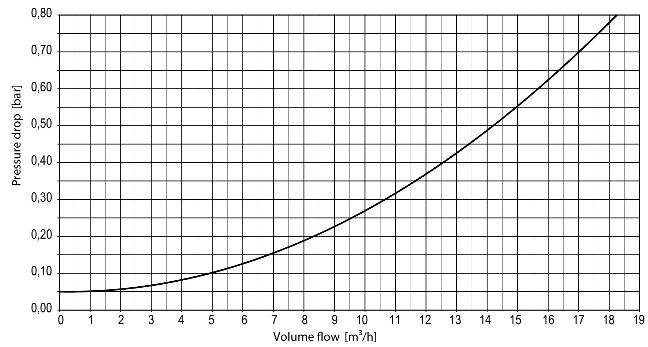


Fig. 8.13: Pressure drop diagram WWM 50

Mixed heating circuit module MMH50

Pre-assembled module (nominal width DN 50) with insulation shells for connecting a mixed heating circuit. A three-way mixer with actuator (connection voltage 230 Volt) also comes pre-installed in the factory. Can be used up to a maximum heating water flow rate of 8.0 m³/h. The module offers space for a circulating pump with a pump dimension of 280 mm (with flange and compensation piece) with a nominal width DN 32 and a spacing of 180 mm.

Fig. 8.14: Design MMH 50

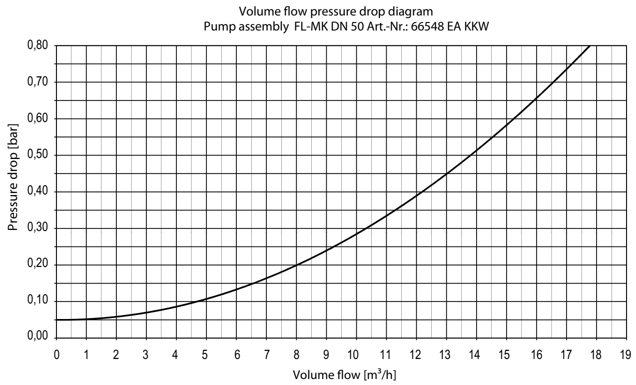
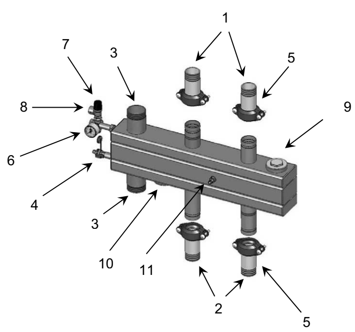


Fig. 8.15: Pressure drop diagram MMH 50



1	Connections heating 2" external thread
2	Connections heat pump 2" external thread
3	Connections buffer tank 1 1/4" external thread
4	KFE ball valve
5	Vitaulic clamp (four in total)
6	Pressure gauge
7	Safety valve 3 bar
8	T-joint for MAG connection
9	Sealing plugs for check valve
10	Sealing plugs
11	Immersion sleeve for return sensor

Table 8.4: Dual differential pressureless manifold (DDV) for the connection of a mixed heating circuit, external supplementary heating and optional domestic hot water preparation.

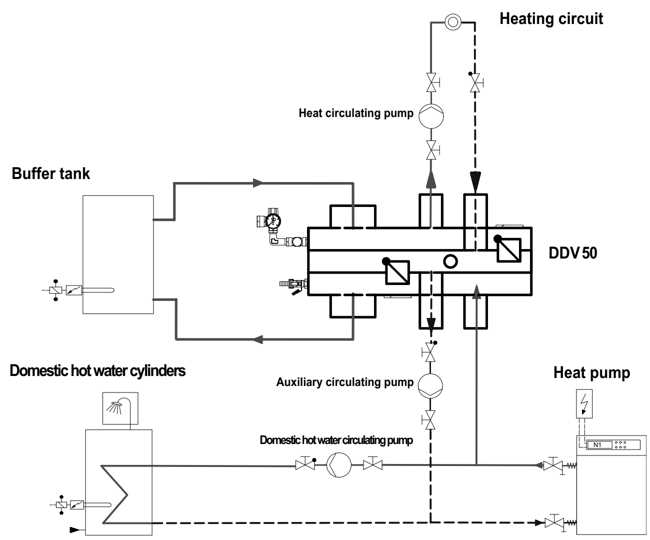


Fig. 8.16: Integration of the dual differential pressureless manifold for heating operation and domestic hot water preparation

NOTE

The DDV 50 is included as an accessory with NTC-2 (for WPM 2004 and WPM 2006plus) and NTC-10 (for WPM 200 and WPM Econ Plus) return temperature sensors.

NOTE

Circulating pump type UPE 120-32 is available as an accessory as a pump for the main heat pump circuit.

NOTE

The installation height of the DDV 50 with a pump inside micrometer of 180 mm is around 0.8 m.

8.5 Hydro tower

The hydro tower HWK 332 delivers heat pump hydraulics the most limited of spaces. It consists of a 100 litre buffer tank and a 300 litre tank with pre-assembled heat pump hydraulics. The hydraulics including components and pump modules for an unmixed heating circuit with one circulating pump each in the generator and consumer circuit are installed in a compact and space-saving hydro tower. The hydro tower is connected to the heat pump via two hydraulic connecting cables and one electrical connecting cable. All electrical components such as circulating pumps, sensors and heating element come pre-installed.

8.5.1 General properties

Benefits of the hydro tower:

- Low installation effort
- All components easily accessible
- Integrated 100l buffer tank reduces operating cycles of the heat pump, thus increasing the efficiency of the system
- Integrated 300l domestic hot water cylinder with built-in flange heater (1.5 kW) for thermal disinfection
- The stepless adjustable operation of the circulating pump in the heating circuit permits adjustment of the output according to need.
- Switchable pipe heater (2 / 4 / 6 kW) for supplementary heating
- Optional immersion heater up to 6 kW
- Ready-to-connect, contains all essential components, i.e. pumps, shut-offs, safety devices and heat pump manager(HWK 332 Econ)

Hydraulic components

- Buffer tank, 100 litres
- 300 litre domestic hot water cylinder
- Dual differential pressureless manifold

Safety equipment:

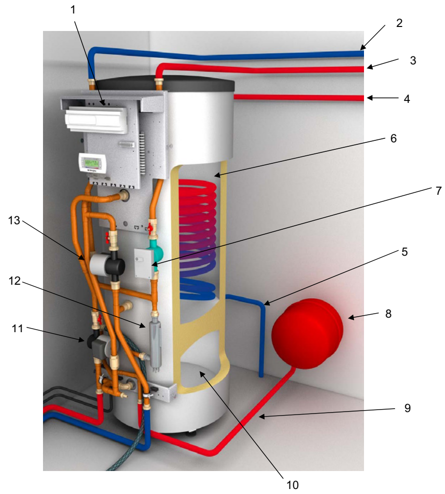
- Safety valve, start-to-leak pressure 2.5 bar
- Easy connection of the required expansion vessel (not included in scope of delivery).

Electrical components :

- Switch box complete with heating contactor and connection terminals
- Heat pump manager (HWK 332Econ and HWK 332 Econ-E hydro towers only)
- 2nd heat generator, electrical pipe heater, heat output 2 / 4 / 6 kW, secured via safety temperature limiter
- Unmixed heating circuit incl. controlled circulating pump (infinitely adjustable or 3 stages), shut-offs and back-pressure feature
- Primary circuit heat generation incl. circulating pump (3 stages,), shut-offs

NOTE

The required expansion vessel and the matching pressure gauge are not included in the scope of delivery and must be ordered separately.



1	WPM EconPlus (not with HWK 332)
2	Heating return
3	Heating flow
4	Domestic hot water flow
5	Cold water inflow
6	300 litre domestic hot water cylinder
7	Electronically regulated circulating pump (M13)
8	Expansion vessel
9	Connecting pipe expansion vessel
10	100 litre series buffer tank
11	Domestic hot water circulating pump (M18)
12	Switchable pipe heater (2/4/6 kW)
13	Uncontrolled auxiliary circulating pump (M16)

Fig. 8.17: Design hydro tower HWK 332Econ

8.5.2 Field of application hydro tower HWK 332 /HWK 332 Econ/HWK 332 Econ-E

The hydro tower HWK is available in the versions HWK 332 (without heat pump manager), HWK 332 Econ (heat pump manager WPM EconPlus) and hydro tower HWK 332 Econ-E (with heat pump manager WPM EconPlus). The following table shows the combination options for heat pumps and hydro towers.

Order reference	For device type
HWK 332	LA 11TAS (LA 11MAS) LA 11 to 22PS LI 9TES, LI 11TES,LI 20TE SI 6 to 11TU SIH 5 to 11TE WI 10TU, WI 14TU
HWK 332 Econ	LA 9TU, LA 12TU, LA 17TU
HWK 332 Econ-E	LA 6TU

Table 8.5: Combination options for hydro towers and heat pumps

NOTE

The hydro tower HWK 332 can also be combined with the high-efficiency air-to-water heat pumps LA 6 to 17TU. In this case, the hydro tower must be connected to the wall-mounted heat pump manager WPM EconPlus or WPM EconPlus-E (with LA 6TU) in accordance with the installation instructions.

8.6 Buffer tank

A buffer tank connected in series is recommended for heat pump heating systems, to ensure the minimum heat pump runtime of 6 minutes for all operating statuses.

Air-to-water heat pumps with defrosting by reverse circulation extract the energy required for defrosting from the heating system. In the case of air-to-water heat pumps, a buffer tank connected in series, into which the screw-in heater is installed, must be installed in the flow in mono energy systems to ensure defrosting.

With split air-to-water heat pumps, the buffer tank can be installed in the heating return, as these pumps have integrated pipe heating.

NOTE

During the commissioning of a air-to-water heat pump the heating water must be pre-heated to the lower operating limit of at least 18 °C to ensure defrosting.

ATTENTION!

An electric heating element which is fitted in a buffer tank must - as a heat generator - be protected by fuse according to DIN EN 12828. It must also be additionally equipped with an expansion vessel that cannot be shut off as well as with a type-tested safety valve.

When implementing brine-to-water or water-to-water heat pumps, the buffer tank can be installed in the flow or, in a purely monovalent mode of operation, even in the return flow.

Buffer tanks connected in series are operated on the temperature level required by the heating system. They are not used for bridging shut-off times (see Chapt. 8.6.3 on page 104).

In heavily-constructed buildings and for the use of panel heating systems in general the sluggishness of the heating system compensates for possible shut-off times.

Heat pump manager timer functions offer the possibility to compensate for set shut-off times through programmed raises.

NOTE

The recommended capacity of the buffer tank connected in series is approximately 10 % of the heating water flow rate of the heat pump per hour. A volume of approximately 8 % is sufficient for heat pumps with two performance levels. However, it should not exceed 30 % of the heating water flow rate per hour.

Overdimensioned buffer tanks lead to longer compressor runtimes. In heat pumps with two performance levels this may lead to the unnecessary switching on of the second compressor.

ATTENTION!

Buffer tanks are not enamelled and, for this reason, should never be used for heating water for domestic use. Buffer tanks should be installed within the thermal envelope of the building in a completely frost-free location.

8.6.1 Heating systems with individual room control

With individual room control the required room temperature can be adjusted without changing the settings of the heat pump manager. If the room set temperature set at the room temperature controller is exceeded, the actuators close so that the heating water no longer flows through the overheated rooms.

If individual heating circuits are closed and the volume flow is thus reduced, part of the heating water flow rate flows through the overflow valve or the differential pressureless manifold. This causes the return temperature to rise and the heat pump to be switched off.

In systems with buffer tanks connected in series the heat pump switches off before all rooms have been sufficiently supplied. A renewed start-up of the heat pump is prevented on account of the utility requirement that a heat pump may only be switched on up to three times per hour.

In the case of systems equipped with a buffer tank, the increase in the return temperature is delayed due to the flow through the tank. No increased system temperatures arise if the tank is connected in series. This increase in circulated heating water volumes result in longer runtimes and an improved average efficiency over the whole year (seasonal performance factor).

NOTE

The buffer tank connected in series increases the circulated heating water volume and guarantees the operational safety even when only individual rooms require heating.

8.6.2 Heating systems without individual room control

If brine-to-water or water-to-water heat pumps are used in systems **without any controllers in the individual rooms**, the buffer tank can be omitted if the individual heating circuits are sufficiently dimensioned so that minimum compressor runtime of approx. 6 minutes is also ensured in interseasonal transition periods with low heat consumption.

NOTE

If there is no individual room control in the living quarters, a more or less consistent temperature level is reached within the thermal envelope of the building. The heating of individual rooms on a higher temperature level (e.g. bathroom) can partly be achieved through a hydraulic equalisation.

8.6.3 Buffer tank for bridging shut-off times

An additional buffer tank, equipped with a second heat generator and acting as a constantly-regulated buffer tank, is recommended to be installed for the use of heat pumps and in combination with radiators in lightly-constructed buildings (due to small tank capacities). The buffer tank is heated up in combination with the special program heat generator 2 (heat pump manager) according to need. This mixer regulation is activated when the second heat generator is called during a shut-off time. The electric heating element should be set to approx. 80 to 90 °C.

The technical data for the different buffer tanks is listed below. Type PSP buffer tanks are built-under buffer tanks with sheet steel casing, i.e. the relevant heat pump can be installed directly on the buffer tank. PSW tanks are floor-mounted buffer tanks with a foil covering.

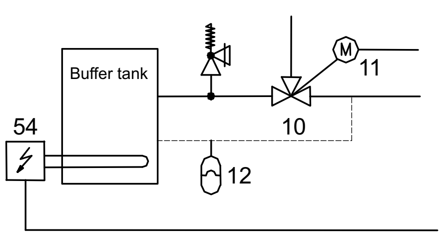


Fig. 8.18: Heating operation with constantly-regulated buffer tank

Dimensions and weights	Unit	PSP 100E	PSP 120E	PSP 140E	PSW 100	PSW 200	PSW 500	PSW 1000
Nominal capacity	l	100	120	140	100	200	500	1,000
Diameter	mm				512	600	700	790
Height	mm	550	600	600	850	1,300	1,950	1,983
Width	mm	650	960	750				
Depth	mm	653	780	850				
Heating water return	Inch	1¼" external thread	1¼" external thread	1" external thread	1" internal thread	1¼" internal thread	2 x 2½"	2½"
Heating water flow	Inch	1¼" external thread	1¼" external thread	1" external thread	1" internal thread	1¼" internal thread	2 x 2½"	2½"
Permissible operating overpressure	bar	3	3	3	3	3	3	3
Maximum tank temperature	°C	95	95	95	95	95	95	95
Supporting feet (adjustable)	Unit(s)		4	4		3	3	3
Heating element inserts 1 ½" internal thread	no.	1	1	2	2	3	3	6
Max. heat output per heating element	kW	7.5	9	9	4.5	6	7.5	9
DN 180 flange	no.						1	
Heat loss[1]	kWh / 24h	1.8	2.1	1.5	1.8	2.1	3.2	4.8
Weight	kg	54	72	72	55	60	115	125

1. Room temperature 20°C; cylinder temperature 65°C

Table 8.6: Technical data of the buffer tank

i NOTE

In accordance with Article 3, Para. 3 of the European Pressure Equipment Directive, buffer and domestic hot water cylinders may not carry a CE label. The directive stipulates that "pressure equipment and/or assemblies... must be designed and manufactured in accordance with the good engineering practice valid in a member state to guarantee that they can be used safely."

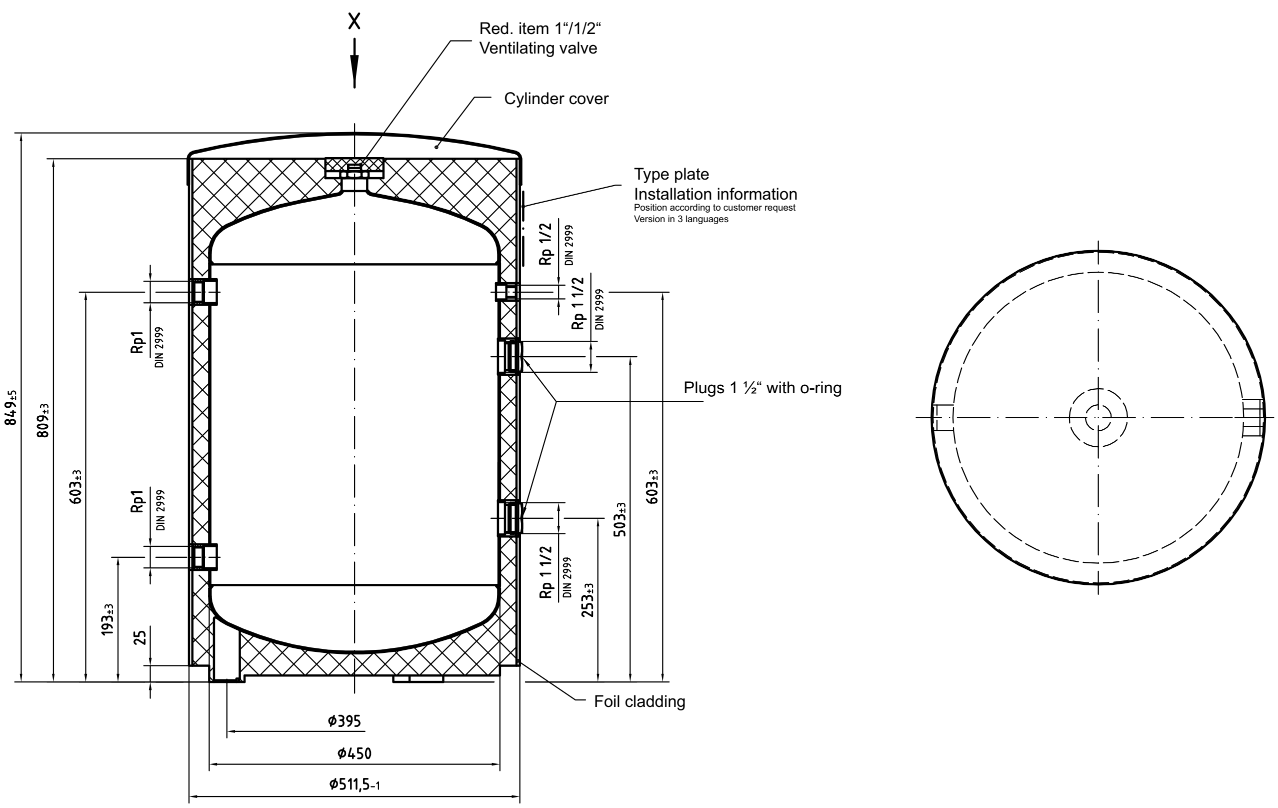


Fig. 8.19: Dimensions of the floor-mounted buffer tank PSW 100 (see also *Table 8.6 on page 105*)

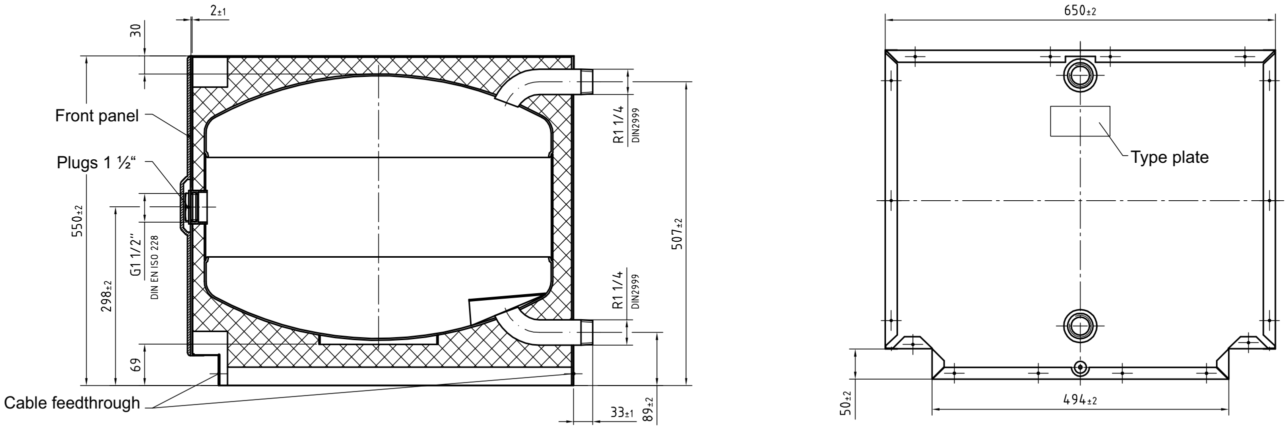


Fig. 8.20: Dimensions of the PSP 100E built-under buffer tank for the compact brine-to-water heat pump (see also *Table 8.6 on page 105*)

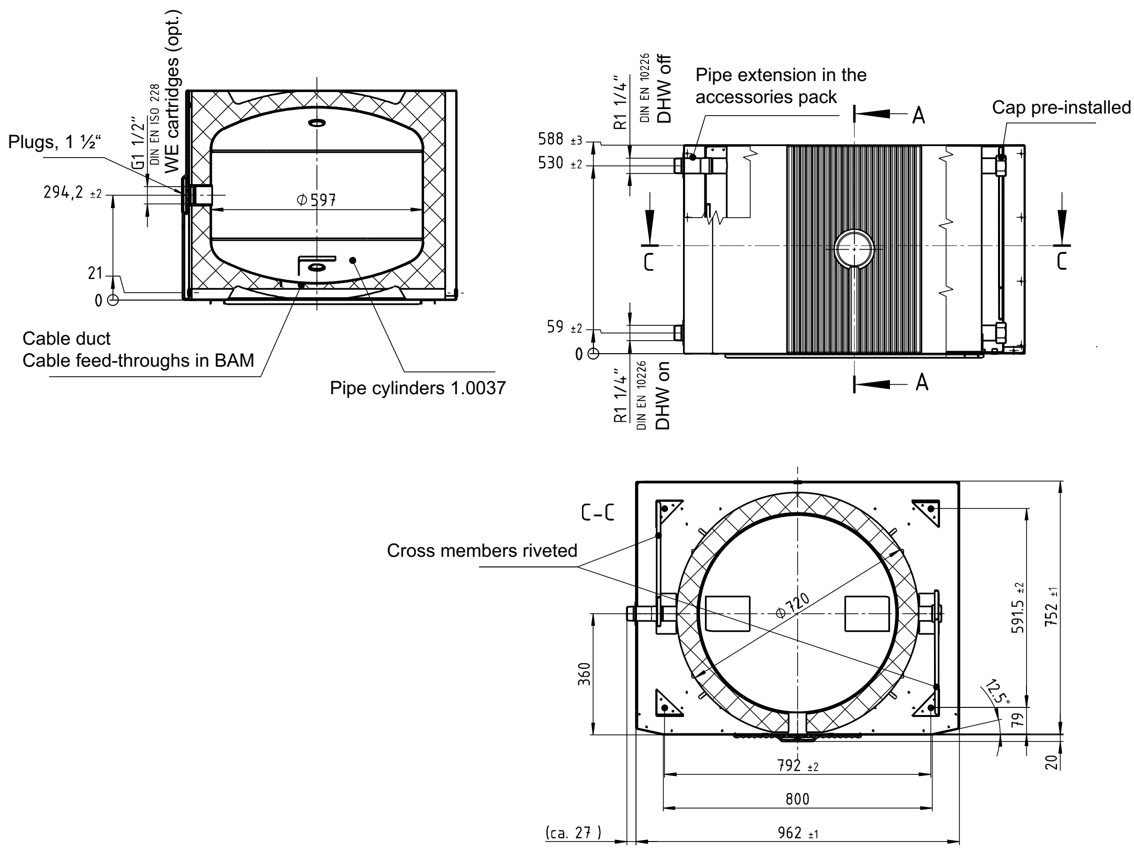


Fig. 8.21: Dimensions of the built-under buffer tank PSP 120E (see also *Table 8.6 on page 105*)

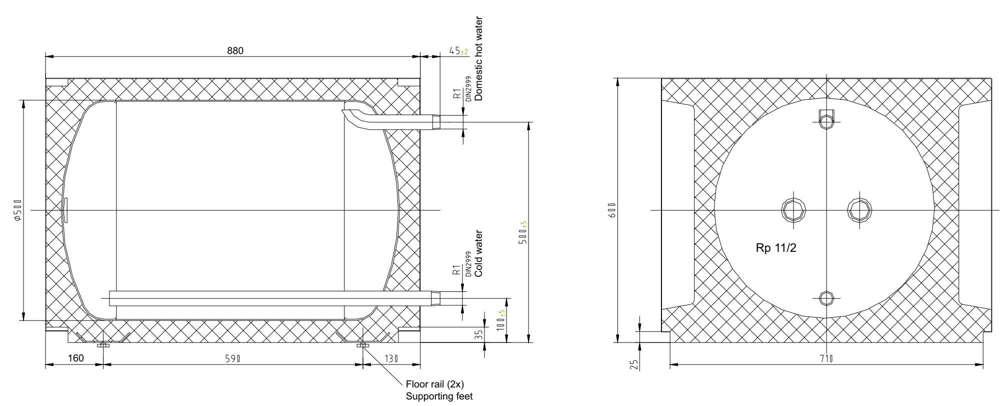


Fig. 8.22: Dimensions of the PSP 140E built-under buffer tank for air-to-water heat pumps installed indoors (see also *Table 8.6 on page 105*)

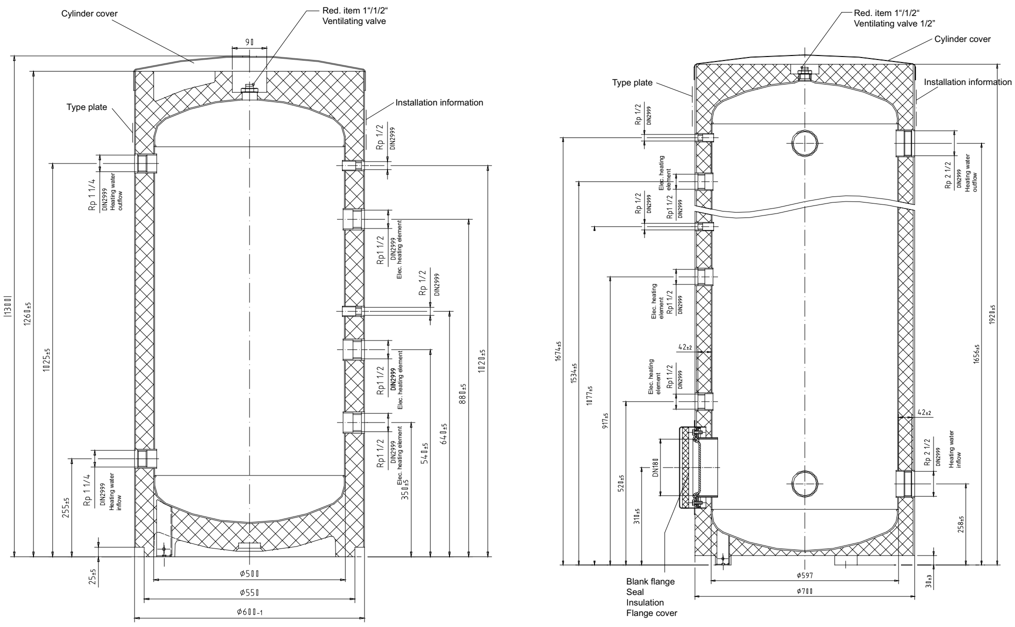


Fig. 8.23: Dimensions of the 200 l and 500 l buffer tanks (see also *Table 8.6 on page 105*)

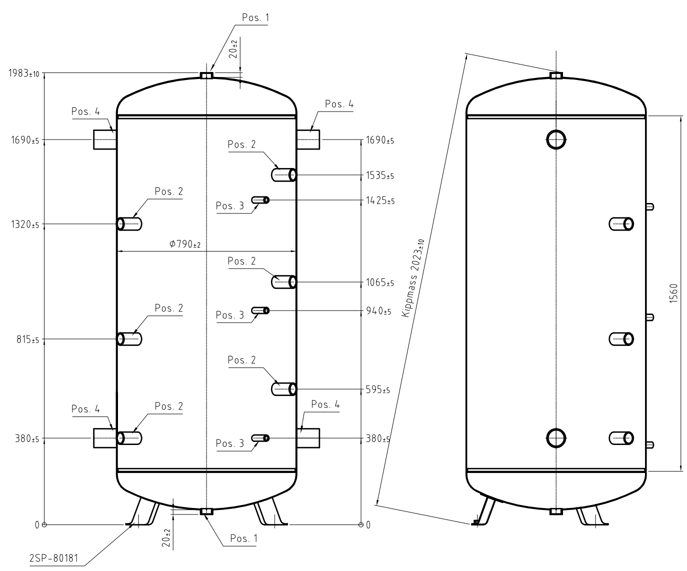


Fig. 8.24: Dimensions 1000l buffer tank

8.6.4 Expansion vessel / safety valve in the heat pump circuit

When water is heated up, there is an increase in pressure in the heat pump circuit (due to the expansion of the heating water) which must be compensated for by the expansion vessel. The design is dependent on the heating water volume and the maximum system temperatures.

An impermissibly high pressure can build up in the heating system when the system is being filled or the water is being heated. This excess pressure must be discharged via a safety valve according to EN 12828.

Bivalent systems

The expansion vessel and safety valve integrated in the boiler circuit is ineffective if the mixer is closed tightly. For this reason, each heat generator must be equipped with a separate safety valve and expansion vessel. These are dimensioned according to the total volume of the system (heat pump, cylinder, radiators, pipework, boiler).

8.6.5 Check valve

If a water circuit contains more than one circulating pump, each pump unit must be equipped with a check valve to prevent mixing from other heating circuits. It should be ensured that check valves close tightly and are noiseless during flow-through.

i NOTE

Dirt particles can prevent the valves from fully closing. This could, for example, lead to insufficient domestic hot water temperatures and swimming pool temperatures if cold heating water is added during domestic hot water preparation and swimming pool heating.

8.7 Flow temperature limit of underfloor heating

Many underfloor heating pipes and screed floorings should not be heated over 55 °C. In the case of bivalent operation or if the buffer tank is charged externally, a limitation of the flow temperature must be effected to prevent such overheating.

NOTE

With a mixer in the underfloor heating circuit or in bivalent-renewable operating mode, the mixer is closed when the temperatures are too high. A safety temperature monitor prevents increased system temperatures due to mixer sluggishness or failure.

8.7.1 Flow temperature limiting via a mixer limit switch

The mixer is only opened wide enough at full boiler output and maximum boiler temperature that the maximum flow temperature of approx. 55 °C is not exceeded. A further mixer open command is prevented by locking the freely controllable mixer limit switch in this position.

We recommend installing a mixer motor equipped with a limit switch so that the drive can be switched off electrically.

8.7.2 Flow temperature limiting via a mixer bypass

At full boiler output, maximum boiler temperature and with the mixer opened completely, the bypass is opened so wide that the maximum flow temperature is not exceeded. This limits the flow temperature. The regulator valve must be secured against accidental adjustment.

We recommend using mixers equipped with an internal bypass.

This type of flow temperature limiting is particularly suitable for underfloor heating.

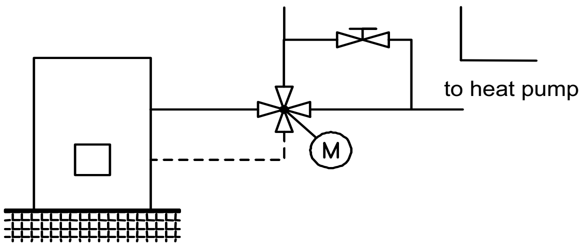


Fig. 8.25: Bypass circuit for safeguarding the maximum flow temperature

8.8 Mixer

The mixer is in the “closed” position (for the boiler) in heat-pump-only operation and directs the hot flow water past the boiler. This prevents downtime losses. The mixer is dimensioned according to the boiler output and the flow rate volume.

The mixer drive must have a runtime of between 1 and 6 minutes. The heat pump manager controls the mixer and can be set to this runtime. We recommend using mixers with a runtime of between 2 and 4 minutes.

8.8.1 Four-way mixer

The four-way mixer is generally required for oil boilers with fixed temperature regulation. These may not be operated below temperatures of 70 °C (poss. 60 °C). The mixer mixes the boiler temperature to the current required flow temperature. Using the effect of an injector, it maintains a circulation in the boiler circuit which flows in the opposite direction of the heating system circuit.

This ensures that the heating water returning to the boiler is always hot enough to prevent the dew point in the boiler from being undershot (which in turn would cause the return temperature to rise).

8.8.2 Three-way mixer

The three-way mixer is used to regulate individual heating circuits and is also implemented when low-temperature boilers or condensing boilers with burner regulation are used (e.g. “variably-regulated boilers”). These types of boilers can have cold return water circulating through them.

The three-way mixer thus serves as a kind of switching valve. It is completely closed in heat pump only operation (prevents downtime losses) and is completely open in boiler operation.

8.8.3 Three-way solenoid valve (switching valve)

Three-way solenoid valves are not to be recommended for this application because they do not function reliably and can transmit sound to the heating system.

8.9 Scale formation in domestic hot water heating systems

Scale formation in domestic hot water heating systems cannot be avoided, but in systems with flow temperatures below 65 °C, the problem can be disregarded. With medium or high-temperature heat pumps and in particular with bivalent systems in the higher output range (heat pump + boiler combination), flow temperatures of 60 °C and more can be achieved. The following standard values should therefore be adhered to regard the filling and make-up water according to VDI 2035, sheet 1: These values can be found in the table.

Total heat output in [kW]	Specific system volume (VDI 2035)		
	< 20 l/kW	≥ 20 < 50 l/kW	≥ 50 l/kW
< 50kW	≤ 16.8 °dH	≤ 11.2 °dH	*< 0.11 °dH* [1]
50 - 200 kW	≤ 11.2 °dH	≤ 8.4 °dH	*< 0.11 °dH* [1]
20 - 600 kW	≤ 8.4 °dH	*≤ 0.11 °dH* [1]	*< 0.11 °dH* [1]
> 600	*< 0.11 °dH* [1]	*< 0.11 °dH* [1]	*< 0.11 °dH* [1]

1. This value lies outside the permissible value for heat exchangers in heat pumps (see Fig. 8.8 on page 109).

Table 8.7: Guideline values for filling and make-up water in accordance with VDI 2035

Irrespective of the legal requirements, the following limit values for the heating water used for different materials must not be undercut or exceeded to guarantee safe heat pump operation. A water analysis must be carried out before commissioning the system. If the water analysis shows a "-" for a maximum of one indicator or a "o" for a maximum of two indicators, the analysis must be classed as negative.

Evaluation characteristic	Concentration range (mg/l or ppm)	Stainless steel	Copper
HCO_3^-	<70	+	o
	70-300	+	+
	>300	+	o/+
Sulfate (SO_4^{2-})	<70	+	+
	70-300	+	o/-
	>300	o	-
HCO_3^- / SO_4^-	<1.0	+	+
	>1.0	+	o/-
Electrical conductivity	< 10 µS/cm	+	o
	10-500 µS/cm	+	+
	> 500 µS/cm	+	o
pH-value	< 6.0	o	o
	6.0-7.5	o/+	o
	7.5-9.0	+	+
	> 9.0	+	o
NH_4^+	< 2	+	+
	2-20	+	o
	> 20	+	-
Cl^-	<300	+	+
	>300	o	o/+
Cl_2	<1	+	+
	1-5	+	o
	> 5	o/+	o/-
Hydrogen sulphide (H_2S)	< 0.05	+	+
	> 0.05	+	o/-
CO_2	< 5	+	+
	5-20	+	o
	>20	+	-
Water hardness (°dH)	4.0-8.5	+	+
Nitrate (NO_3)	<100	+	+
	>100	+	o
Iron (Fe)	< 0.2	+	+
	> 0.2	+	o
Aluminium (Al)	< 0.2	+	+
	> 0.2	+	o
Manganese (Mn)	< 0.1	+	+
	> 0.1	+	o

Table 8.8: Limit values for the quality of heating water

Resistance of copper-soldered or welded stainless-steel plate heat exchangers to substances contained in the water

Notes

"+" = Normally good resistance

"o" = corrosion problems can arise,
particularly if several factors receive a evaluation of "o".

"-" = should not be used

The water quality should be checked again after 4 - 6 weeks, as the quality could change during the first few weeks of operation due to chemical reactions.

8.10 Contaminants in the heating system

When installing a heat pump in a new or existing heating system, the system should be flushed to remove deposits and suspended matter. These types of contaminants can reduce the heat transfer of the radiators, impede the flow or collect in the condenser of the heat pump. In extreme cases, they can cause the heat pump to switch off automatically. Oxidation products (rust) can form if oxygen enters the heating water. Contamination caused by remnants of organic lubricants and gasket material can also occur frequently. Both sources of contamination can lead - either individually or together - to a reduction in the efficiency of the heat pump's condenser. In such cases, the condenser must be cleaned.

Detergents should only be used with caution because of their high acid content. The regulations of relevant employers' liability insurance associations should be observed. Always consult the manufacturers of the chemicals in case of doubt!

ATTENTION!

The heating system should be neutralised with suitable chemicals after cleaning to avoid subsequent damage.

The heat pump should generally be disconnected from the heating system before flushing. Isolating valves should be fitted in the flow and return to prevent the heating water from leaking. The water connections on the heat pump are used for flushing.

In the case of heating systems equipped with steel components (e.g. pipes, buffer tank, boiler, manifold, etc.), there is always the danger of excess oxygen causing corrosion. This oxygen enters the heating system via the valves, the circulating pumps and/or plastic pipes.

NOTE

We therefore recommend equipping diffusion-open heating system with an electrophysical anti-corrosion system. According to today's state of knowledge, an ELYSATOR system is well suited for this kind of use.

8.11 Integration of additional heat generators

8.11.1 Constantly regulated boiler (mixer regulation)

When implementing this type of boiler, the boiler water is always heated to a set temperature (e.g. 70 °C) when the command is issued accordingly by the heat pump manager. This temperature must be set so high that domestic hot water preparation can also be carried out by the boiler (according to need).

Regulation of the mixer is undertaken by the heat pump manager. If required, it calls for the boiler and adds more domestic hot water until the desired set return temperature or domestic hot water temperature is reached.

The boiler is called via the 2nd heat generator output of the heat pump manager and the mode of operation of the 2nd heat generator is coded as being "constant".

NOTE

When the special program heat generator 2 is activated, the boiler is maintained at operating temperature for at least 30 hours after the command is issued to prevent corrosion caused by short runtimes.

8.11.2 Variably regulated boiler (burner regulation)

In contrast to constantly-regulated boilers, variably-regulated boilers supply domestic hot water at a temperature that is directly based on the respective outside temperature. The three-way reversing valve has no regulatory function. However, it has the task of directing the heating water flow past or through the boiler, depending on the operating mode. In the case of heat-pump-only operation, the heating water is directed past the boiler to avoid losses caused by heat dissipation of the boiler. No separate burner regulation is required for bivalent systems because control can be undertaken by the heat pump manager. If the system is equipped with atmospherically controlled burner regulation, the voltage supply for burner regulation should be disconnected in the case of heat pump only operation. The boiler is controlled via the 2nd heat generator output of the heat pump manager, and the mode of operation of the 2nd heat generator is coded as being “variable”. The characteristic curve of the burner regulation is set according to the heat pump manager.

NOTE

It is not possible to control an additional immersion heater for supplementary heating (E10.1) in a bivalent system.

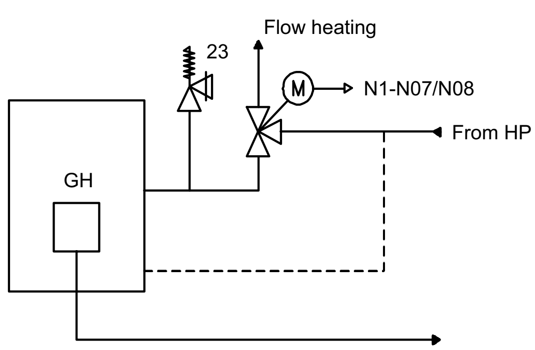


Fig. 8.26: Circuit diagram for variably-regulated boiler operation

8.11.3 Renewable heat generators

The heat pump manager has a separate operating mode for the integration of renewable heat generators such as solid fuel boilers or thermal solar energy systems. The “bivalent-renewable” operating mode can be chosen during the preconfiguration. In this operating mode, the heat pump heating system responds like a mono energy system; when heat is supplied by the renewable heat source, the heat pump is automatically blocked and the heat generated by the renewable heat source is mixed into the heating system. The mixer outputs of the bivalence mixer (M21) are active.

If the temperature in the renewable cylinder is high enough, the heat pump is also blocked during domestic hot water preparation or swimming pool requests.

Heat pumps which are not equipped with a flow sensor (R9) must be retrofitted with one. In reversible heat pumps or heat pump heating systems with a third heating circuit, “bivalent-renewable” is not available since the sensor (R13) is already in use.

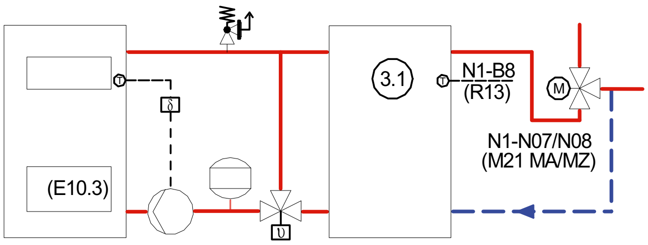


Fig. 8.27: Circuit example for heating operation with a solid fuel boiler

8.12 Heating a swimming pool

Swimming pool heating is integrated parallel to the heating and domestic hot water heat pump. The swimming pool is heated by means of a swimming pool heat exchanger (hydraulic integrationsee Fig. 8.54 on page 127).

A	Filter
B	Filter pump
C	Swimming pool controller (thermostat)
D	Timer
M19	Swimming pool water pump
RBG	Relay module

We recommend controlling the swimming pool heating via a time switch. The heating requirements of the swimming pool should only be forwarded to the heat pump manager if the swimming pool pump (M19) is running and the filter pump is switched on.

The transmission capacity of the heat exchanger must be based on the specific features of the heat pump, e.g. maximum flow temperature of 55 °C and the minimum heating water flow rate of the heat pump.

Not only the nominal output, but also the construction, the flow rate through the heat exchanger and the thermostat setting are important criteria for making a selection. The design temperature of the pool (e.g. 27 °C) and the flow rate in the pool circuit should also be taken into account when designing the system.

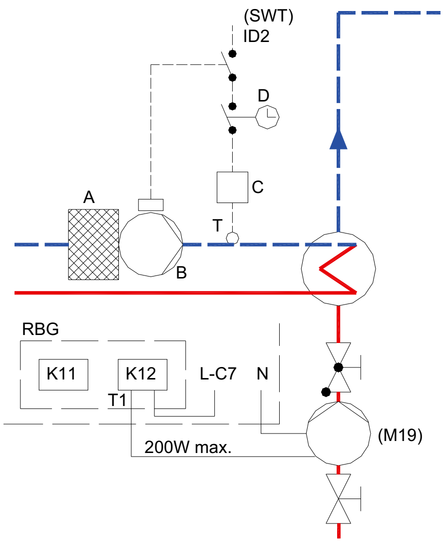


Fig. 8.28: Integration of swimming pool heating with heat pumps

> **NOTE**
> **The integration shown only applies for heat pumps with heat pump manager WPM 2006/2007.**

> **NOTE**
> **In heat pump heating systems with no auxiliary circulating pump M16 (e.g. no dual differential pressureless manifold Chapt. 8.4.3 on page 100), this pump output can be used to control the swimming pool circulating pump. In the menu "Settings - Plant - Pump control", the setting for "Aux. pump pool" must be set to "Yes".**

8.13 Constantly regulated tank charging

Two buffer tank thermostats and one contactor (2 contacts) are necessary for regulation of buffer tanks with large volumes which are to be charged with a constant temperature.

NOTE

The illustrated circuit ensures full charging of the buffer tank, and in this way, prevents the heat pump from surging.

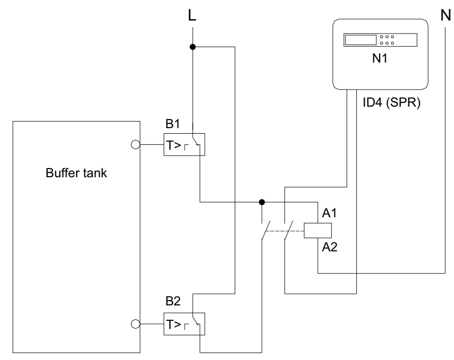


Fig. 8.29: Regulation for constantly-regulated tank charging

8.14 Electronically controlled circulating pumps in heating systems

The European Ecodesign Directive calls for electronically controlled circulating pumps to be used from 01.01.2013. With electronically controlled circulating pumps, the volume flow or speed of the pump is controlled via the pressure drop in the heating circuit. If the heat load in a building falls, the thermostat valves close the heating circuit and the pressure in the system increases. The electronically controlled circulating pump detects the rise in pressure and reduces the volume flow accordingly. This means that, eventually, the minimum volume flow can no longer be guaranteed with the heat pump.

If the unregulated circulating pump is to be replaced with an electronically regulated circulating pump in an existing heating system, the hydraulic integration of the heat pump must be checked and adapted where necessary. The required minimum volume flow specified in the heat pump device information must be guaranteed even in the worst case scenario. There are three ways to achieve this:

Install a dual differential pressureless manifold

In this case, the existing overflow valve must be replaced with a dual differential pressureless manifold (see Chapt. 8.4.3 on page 100). The dual differential pressureless manifold guarantees the minimum volume flow even when the heating circuits are closed. The electronically regulated circulating pump is installed as a circulating pump in the heating circuit in this case. If the thermostats are closed, the electronically regulated circulating pump reduces the volume flow.

Controlling the circulating pump via WPM EconPlus

With heat pumps equipped with a WPM EconPlus heat pump manager, there is the option of controlling the electronically regulated circulating pump via the heat pump manager with a 0 - 10 Volt signal following a software update. For this, the electronically regulated circulating pump must have a 0 - 10 Volt input signal. In this case, no upgrading work is required on the hydraulics.

Hydraulic equalisation with overflow valve resetting

The electronically regulated circulating pump is set so that it provides the required minimum heating water flow rate even if the system counter-pressure increases. The overflow valve setting must then be checked in accordance with Chapt. 8.3.3 on page 96. If the minimum heating water flow rate is not complied with, the consumer circuit must be hydraulically disconnected with a differential pressureless manifold.

NOTE

Electronically regulated circulating pumps should only be combined with an overflow valve in new installations if the pump can be activated by the heat pump manager with a 0 - 10 Volt signal.

NOTE

In all three cases, a hydraulic equalisation must be carried out once the retrofitting work is complete and the controller settings of the heat pump manager must be checked.

Electrical connection of electronically regulated circulating pumps

Electronically regulated circulating pumps have high starting currents, which may shorten the service life of the heat pump manager. A coupling relay must therefore be installed between the output of the heat pump manager and the electronically regulated circulating pump.

This is not necessary if the maximum permissible operating current of the heat pump manager of 2 A and the maximum permissible starting current of the heat pump manager of 12 A are not exceeded by the electronically regulated circulating pump or a relevant approval has been issued by the pump manufacturer.

ATTENTION!

It is not permitted to connect more than one electronically regulated circulating pump via a relay output.

8.15 Hydraulic integration

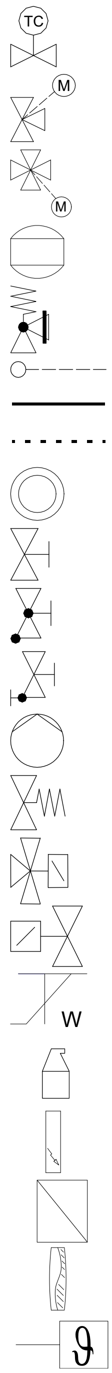
The heating system control is identical for air-to-water, brine-to-water and water-to-water heat pumps; however, the hydraulics for the integration of the heat source are different.

The integration diagrams shown on the following pages show standard solutions for the most common applications. The heat pump manager controls the individual components. The diagrams show the contacts and the hydraulic components of the domestic hot water distribution system (in dashed lines). The max. permissible heating water flow rate must be adhered to (see Chapt. 8.4 on page 97).

Additional integration diagrams can be downloaded from the internet at www.dimplex.de.

Legend

1.	Heat pump
1.1	Air-to-water heat pump,
1.2	Brine-to-water heat pump
1.3	Water-to-water heat pump
1.7	Split air-to-water heat pump
2	Heat pump manager
3.	Series-buffer tank
3.1	Renewable cylinder
4.	Domestic hot water cylinders
5.	Swimming pool heat exchanger
13.	Heat source
14.	Compact manifold
E9	Flange heater
E10	2nd heat generator (HG2)
E10.1	Electric heating element
E10.2	Oil/gas boiler
E10.3	Solid fuel boilers
E10.4	Main cylinder (water)
E10.5	Solar energy system
F7	Safety temperature monitor
K20	Contactor for HG2
K21	Contactor for immersion heater domestic hot water
N1	Heating controller
N12	Solar controller (not included in the scope of supply of the heat pump manager)
M11	Heat source primary pump
M13	Heat circulating pump
M15	Heat circulating pump heating circuit 2
M16	Auxiliary circulating pump
M18	Domestic hot water circulating pump
M19	Swimming pool circulating pump
R1	External wall sensor
R2	Return sensor
R3	Domestic hot water sensor
R5	Sensor, heating circuit 2
R9	Flow sensor
R12	Defrost end sensor
R13	Sensor for heating circuit 3 / renewable cylinder
SMF	Dirt trap
TC	Room temperature controller
EV	Electrical distribution system
KW	Cold water
DHW	Domestic hot water
MA	Mixer open
MZ	Mixer closed
Y13	Three-way reversing valve



Thermostat-controlled valve
Three-way mixer
Four-way mixer
Expansion vessel
Safety valve combination
Temperature sensor
Flow
Return
Heat consumer
Isolating valve
Isolating valve with check valve
Isolating valve with drainage
Circulating pump
Overflow valve
Three-way reversing valve with actuator
Two-way valve with actuator
Safety temperature monitor
Large-capacity breather with micro air bubble deposition
Electric heating element (pipe heater)
Dirt trap
Expansion vessel
Thermostat

i **NOTE**

The following hydraulic integrations are schematic representations of the essential components and are designed as a planning aid.
They do not include all safety devices, components to maintain a constant pressure and any additional isolating devices for maintenance and service work required in accordance with DIN EN 12828.

8.15.1 Integration of the heat source

The heat source primary pump M11 transports the recovered environmental heat to the evaporator of the heat pump. In air-to-water heat pumps, this task is carried out by the integrated fan.

The integration of the ground or ground water as a heat source can be seen in the following figures.

Ground as a heat source

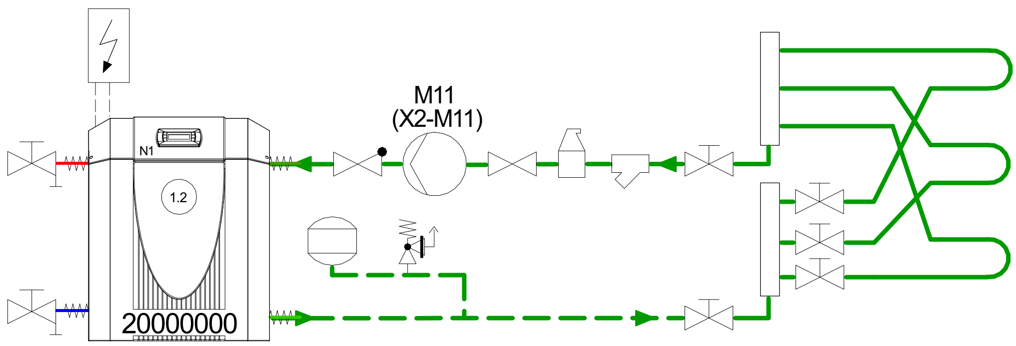


Fig. 8.30: Schematic representation of brine-to-water heat pumps

Every brine circuit should be equipped with at least one isolating valve for ventilating the heat source.
Brine circuits must all be of the same length to ensure that each has an equal flow and abstraction capacity.
The filling and ventilation system should be installed at the site's highest point.
A high-performance fan must be installed at the highest and hottest possible point in the brine circuit.
The brine circulating pump of the heat source system should be installed outside the building where possible and protected from rain.

When installing inside a building, the pump should be insulated with steam-resistant material to prevent the formation of condensation and ice. Sound insulating measures may also be necessary.

Ground water as a heat source

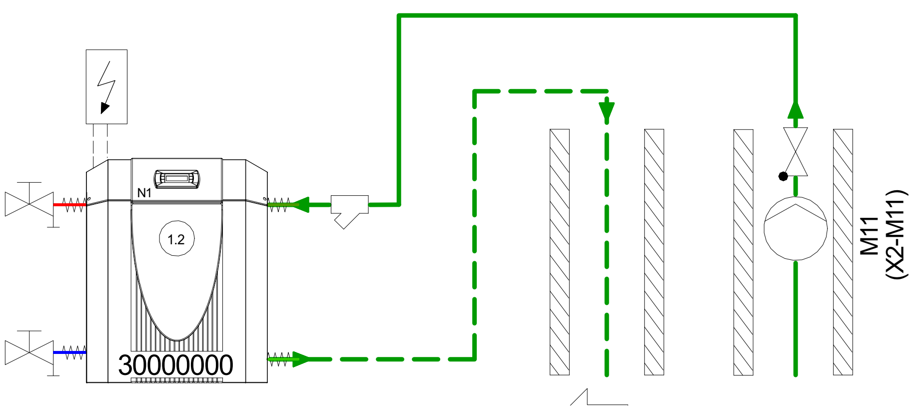


Fig. 8.31: Schematic representation of water-to-water heat pumps

Legend:

Two wells are required for the withdrawal of ground water, an “extraction well” and an “absorption well”. The absorption well must in the direction of ground water flow. The underwater pump and wellheads should have an airtight seal.

1.2 Brine-to-water heat pump
1.3 Water-to-water heat pump
M11 Primary pump for brine or ground water
N1 Heat pump manager Heating

8.15.2 Monovalent brine-to-water heat pumps

A heating circuit with overflow valve

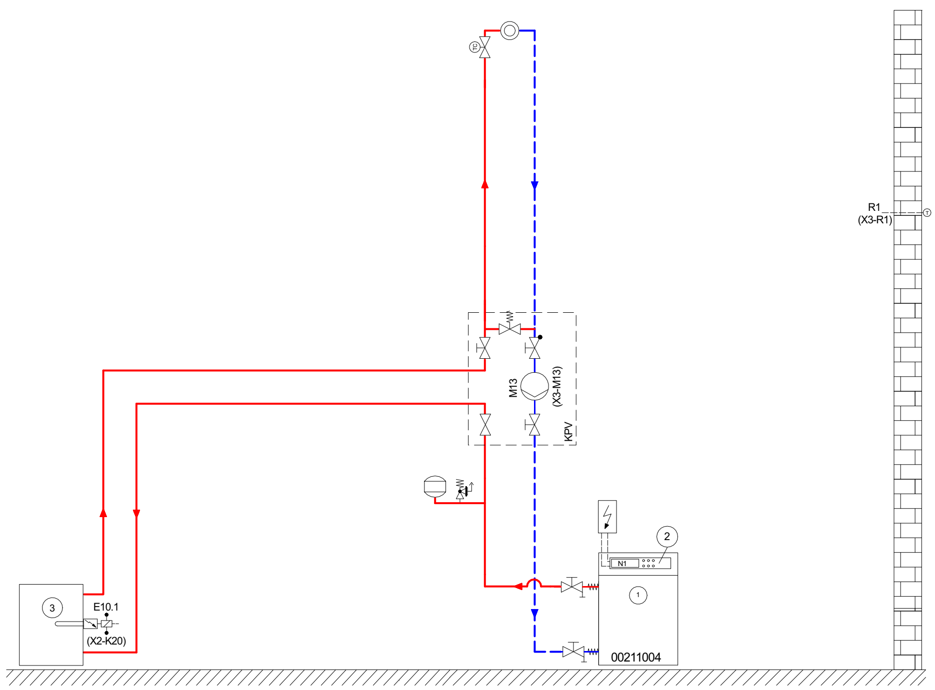


Fig. 8.32: Integration diagram for monovalent heat pump operation with one heating circuit and buffer tank connected in series (a minimum buffer tank volume of 10 % of the minimum throughput must be ensured either by a buffer tank connected in series or other suitable measures)

Pre-configuration	Setting
Operating mode	Mono-valent
1st heating circuit	Heating
2nd heating circuit	No
Domestic hot water	No
Swimming pool	No

In systems which are not equipped with controllers in the individual rooms (TC), the overflow valve must be adjusted - in combination with an unregulated heating pump (M13) - so that the minimum heating water flow rate is ensured for all possible operating conditions.
The buffer tank, connected in series, increases the circulated volume and guarantees the minimum runtimes required by the compressor when only individual rooms require heating (for example, the bathroom).

Two heating circuits with differential pressureless manifold

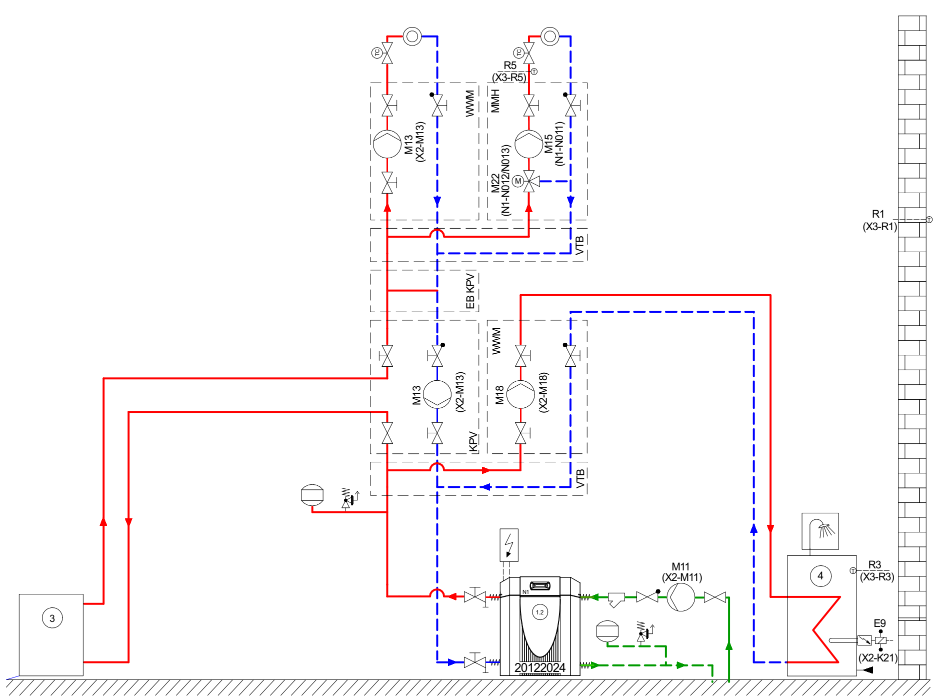


Fig. 8.33: Integration diagram for monovalent heat pump operation with two heating circuits, one buffer tank connected in series and domestic hot water heating

Pre-configuration	Setting
Operating mode	Mono-valent
1st heating circuit	Heating
2nd heating circuit	Heating
3rd heating circuit	No
Domestic hot water	Yes with a sensor
Flange heater	Yes
Swimming pool	No

If there is more than one heating circuit, the generator and consumer circuits must be hydraulically isolated.

The differential pressureless manifold ensures the heating water flow rate and must have the same cross section as the flow and return lines.

Electrical connection of monovalent heat pump heating systems

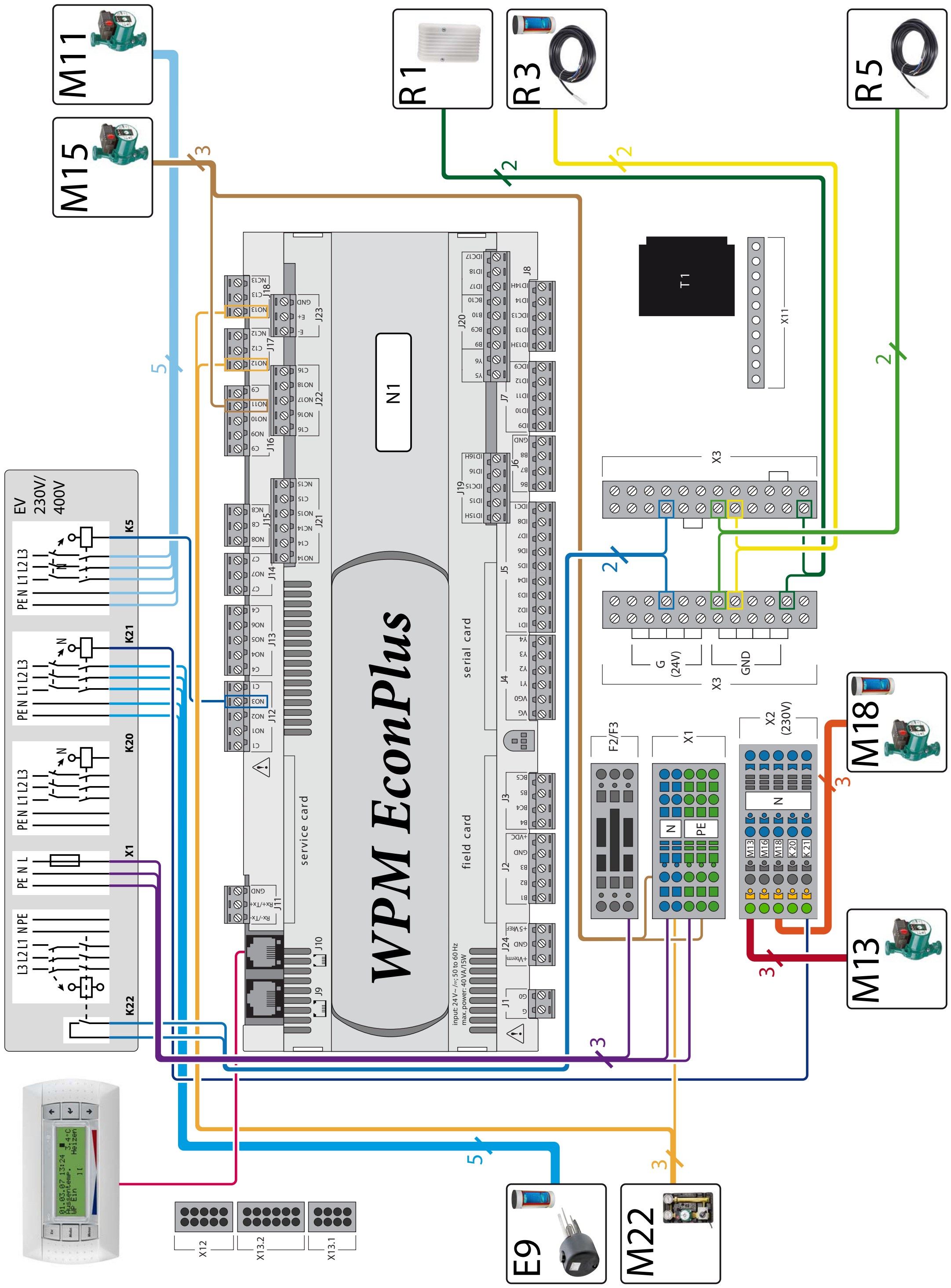


Fig. 8.34: Connection diagram heat pump manager with monovalent systems with two heating circuits and domestic hot water preparation.

The four-core supply cable for the output section of the heat pump is fed from the heat pump meter via the utility company's contactor (if required) into the heat pump (3L/PE~400V,50Hz). The system must be protected according to the power consumption data on the type plate using a 3-pole miniature circuit breaker with C characteristic and common tripping for all 3 paths. Cable cross-section according to DIN VDE 0100.

The three-core supply cable for the heat pump manager (N1) is fed into the heat pump (device with integrated heat pump manager) or to the future mounting location of the wall-mounted heat pump manager. The supply cable (L/N/PE~230 V, 50 Hz) for the heat pump manager must have a constant voltage. For this reason, it should be tapped upstream from the utility blocking contactor or be connected to the household current, because otherwise important protection functions could be lost during a utility block.

8.15.3 Heat pumps in compact design

Compact air-to-water heat pumps

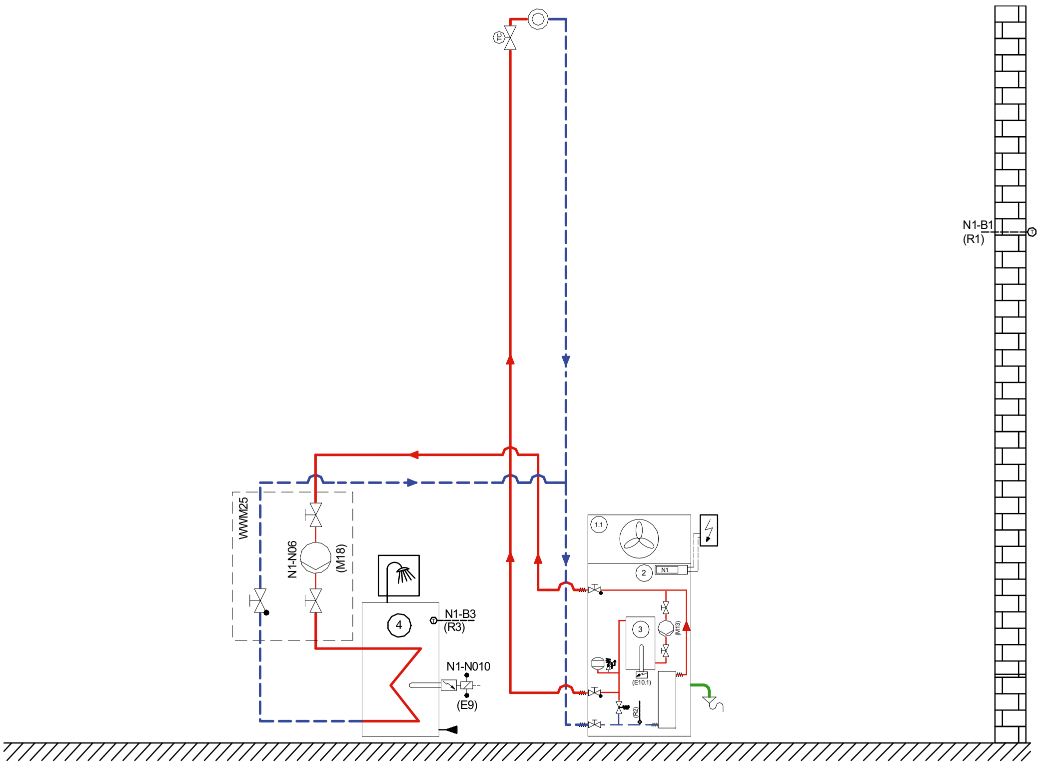


Fig. 8.35: Integration diagram for mono energy heat pump operation with one heating circuit and integrated buffer tank connected in series

Pre-configuration	Setting
Operating mode electric heating	Immersion heater in the buffer
1st heating circuit	Heating
2nd heating circuit	No
Domestic hot water	Yes with a sensor
Flange heater	Yes
Swimming pool	No

The system components for the heat source and an unmixed heating circuit are integrated in a heat pump in compact design.

Domestic hot water preparation is optional.

If required, the 2 kW immersion heater integrated into the compact air-to-water heat pump can be replaced by a pipe assembly.

Integration diagrams are clearly marked through an 8-digit code (e.g. 12211020).

Compact brine-to-water heat pump

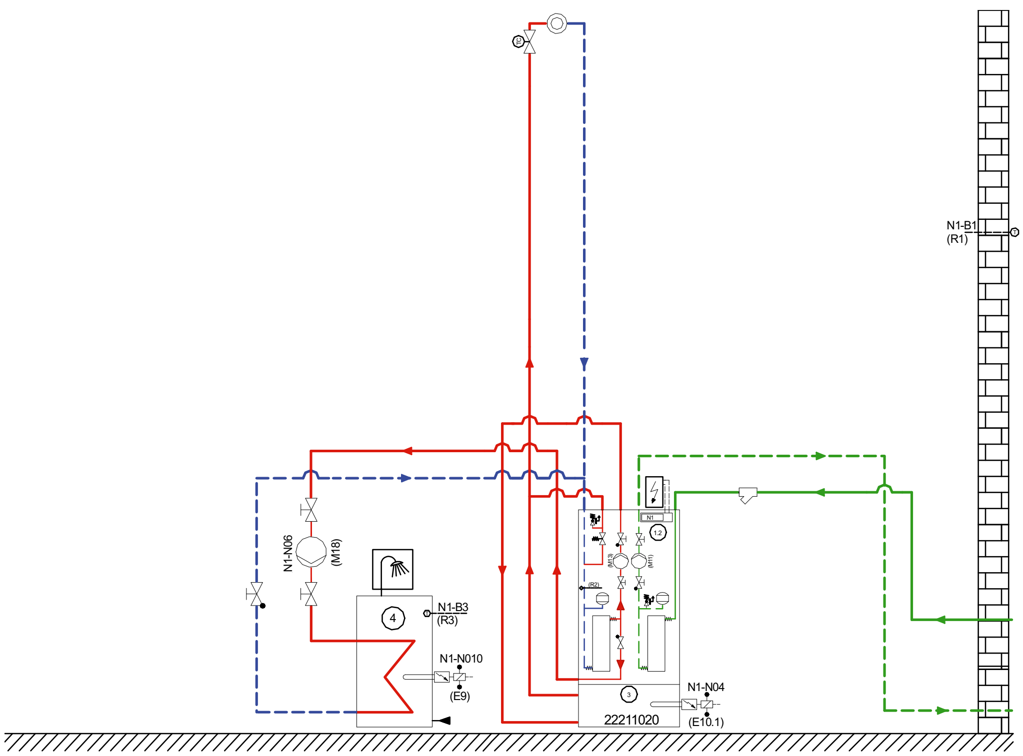


Fig. 8.36: Integration diagram for mono energy heat pump operation with one heating circuit and built-under buffer tank

Pre-configuration	Setting
Operating mode electric heating	Immersion heater in the buffer
1st heating circuit	Heating
2nd heating circuit	No
Domestic hot water	Yes with a sensor
Flange heater	Yes
Swimming pool	No

The compact brine-to-water heat pump can be directly connected to the heating system due to the integrated solid-borne noise insulation.

The free compression of the integrated brine circulating pump is set for a maximum heat exchanger depth of 80 m (DN 32). For a greater heat exchanger depth the free compression must be checked and, if necessary, a DN 40 pipe must be used.

i NOTE

Heat pumps in compact design can not be used for bivalent systems.

8.15.4 Heat pumps with hydro tower HWK 332

Mono energy heat pump heating system with one heating circuit

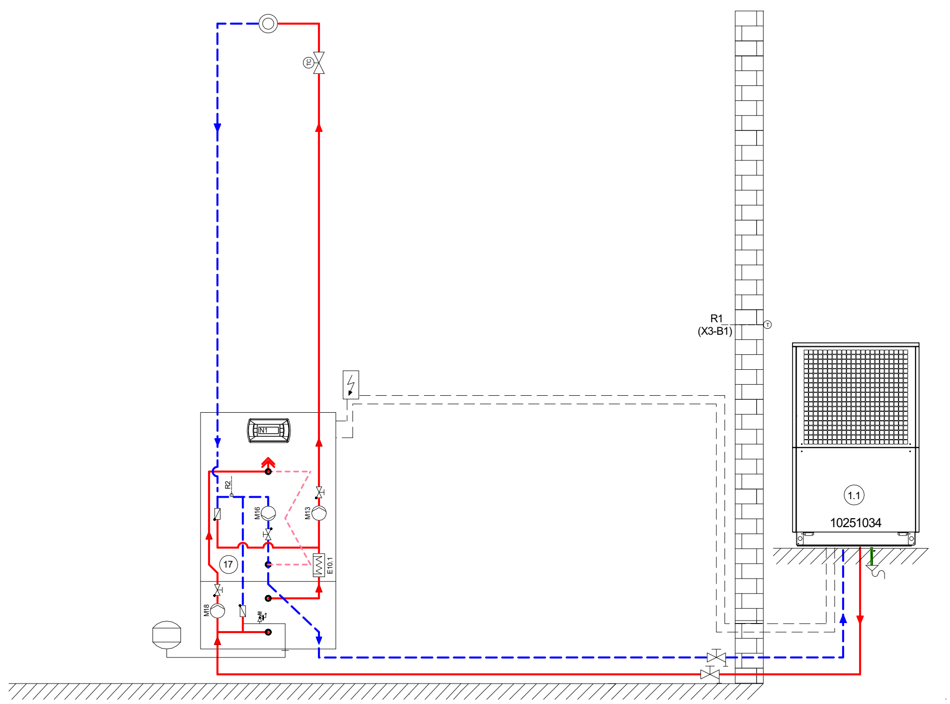


Fig. 8.37: Integration diagram for an air-to-water heat pump installed outdoors with hydro tower HWK 332 Econ

Pre-configuration	Setting
Operating mode electric heating	Pipe heater Heating
1st heating circuit	Heating
2nd heating circuit	No
Domestic hot water	Yes with a sensor
Flange heater	Yes
Swimming pool	No

The hydro tower with integrated WPM EconPlus regulation enables the fast and simple connection of a high-efficiency air-to-water heat pump installed outdoors to a heating system with an unmixed heating circuit. The following components are installed in a space-saving way and wired ready for use:

a 100l buffer tank, a 300l domestic hot water cylinder, a circulating pump for the generator circuit (M16), an electronically regulated circulating pump for the consumer circuit (M13), a domestic hot water circulating pump (M18) and switchable supplementary heating (2, 4, 6kW).

Bivalent heat pump system with supplementary boiler

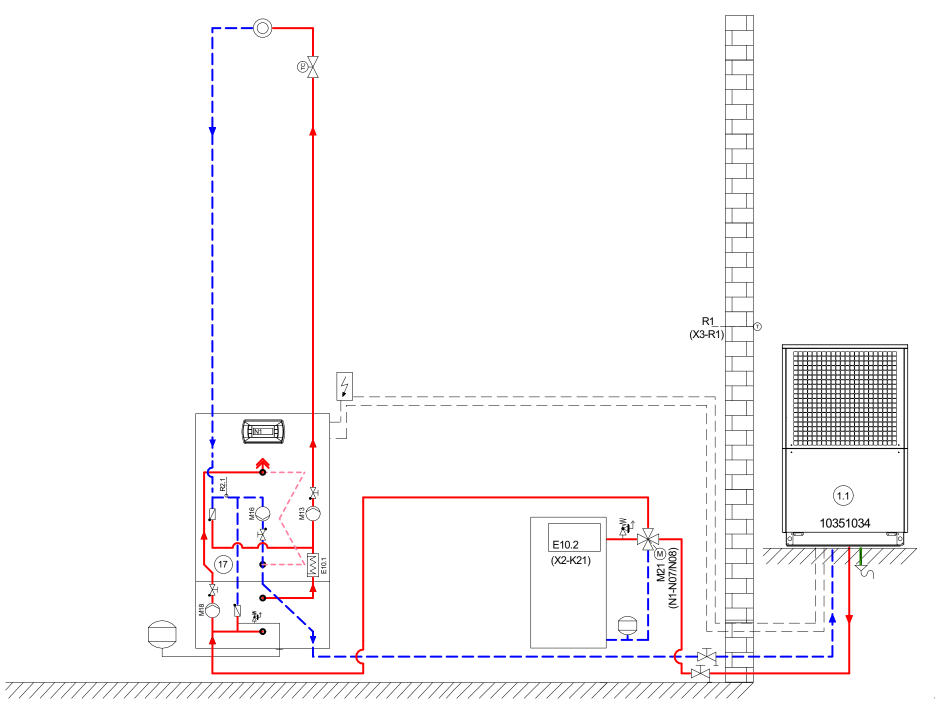


Fig. 8.38: Integration diagram for a bivalent operating mode with boiler and hydro tower HWK 332 Econ

Pre-configuration	Setting
Operating mode	Bivalent heat pump + boiler
1st heating circuit	Heating
2nd heating circuit	No
Domestic hot water	Yes with a sensor
Flange heater	Yes
Swimming pool	No

Hydraulic decoupling of the generator and consumer circuits is carried out using a dual differential pressureless manifold (Chapt. 8.3.5 on page 97).

8.15.5 Mono energy heat pump heating system

A heating circuit with overflow valve

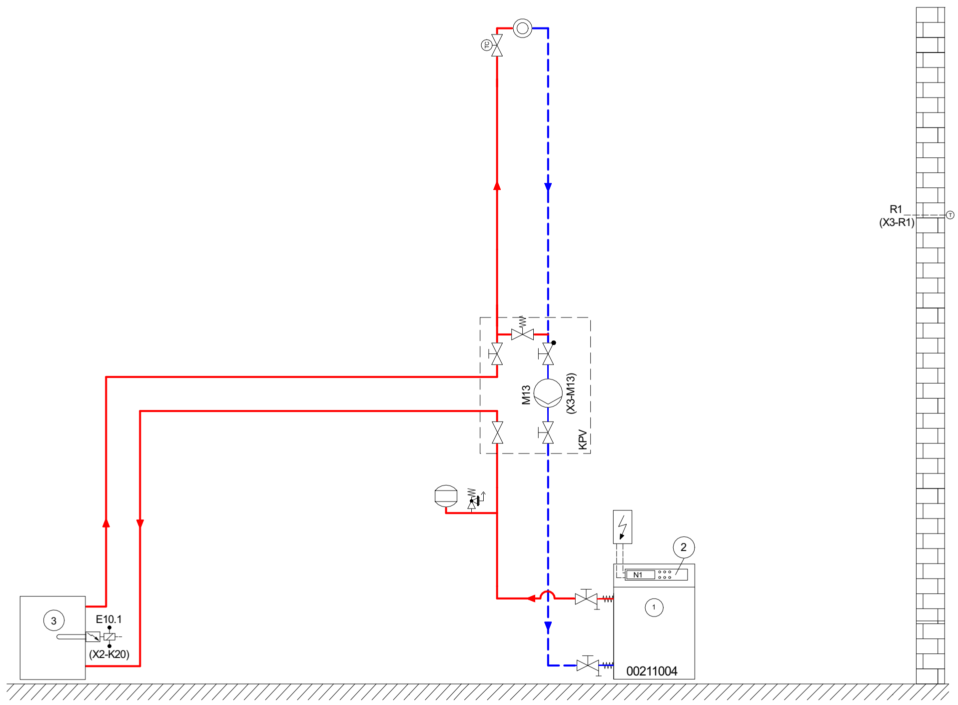


Fig. 8.39: Integration diagram for mono energy heat pump operation with one heating circuit and buffer tank connected in series

Pre-configuration	Setting
Operating mode electric heating	Immersion heater in the buffer
1st heating circuit	Heating
2nd heating circuit	No
Domestic hot water	No
Swimming pool	No

The heating water flow rate must be ensured using an overflow valve that must be set by the technician during commissioning (seeChapt. 8.3 on page 95)

The use of the compact manifold KPV 25 with overflow valve is recommended for heating systems with panel heating and a heating water flow rate up to max. 1.3m^3/h.

If electric heating is installed in the buffer tank, it should be protected as a heat generator according to DIN EN 12828.

Heating circuit with differential pressureless manifold

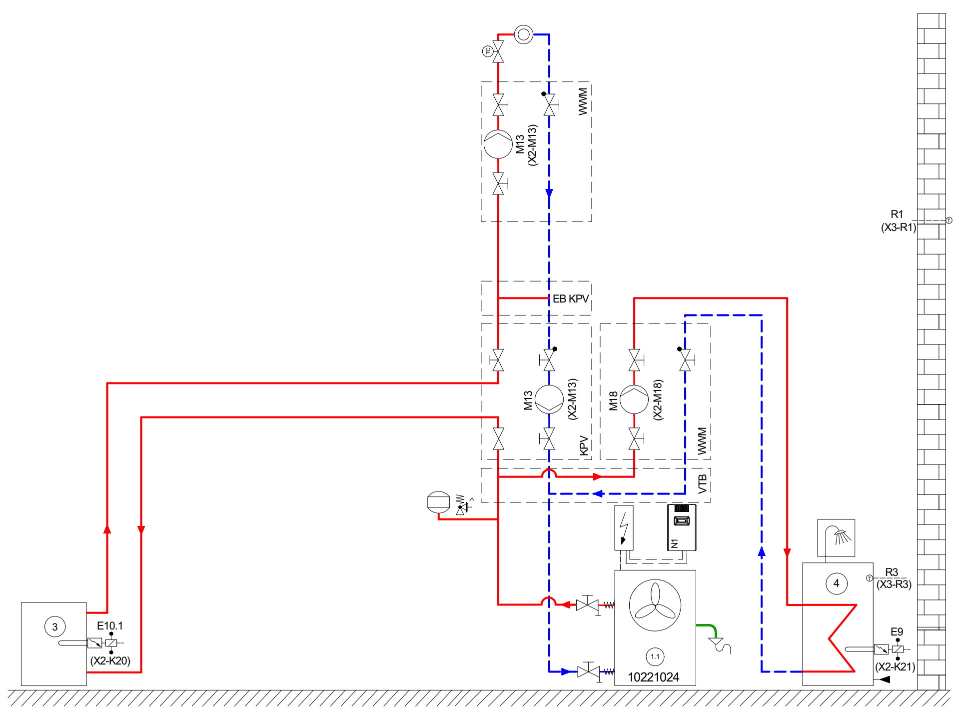


Fig. 8.40: Integration diagram for mono energy heat pump operation with one heating circuit, a buffer tank connected in series and domestic hot water heating

Pre-configuration	Setting
Operating mode electric heating	Immersion heater in the buffer
1st heating circuit	Heating
2nd heating circuit	No
Domestic hot water	Yes with a sensor
Flange heater	Yes
Swimming pool	No

The heating water flow rate must be ensured using a differential pressureless manifold (see Chapt. 8.3.4 on page 96)

The use of the compact manifold KPV 25 with EB KPV extension module is recommended for heat pumps with a heating water flow rate of up to max. 2m^3/h.

A method of manual drainage must be provided for heat pumps which are exposed to frost (see Chapt. 8.2 on page 94).

Heating circuits with differential pressureless manifold

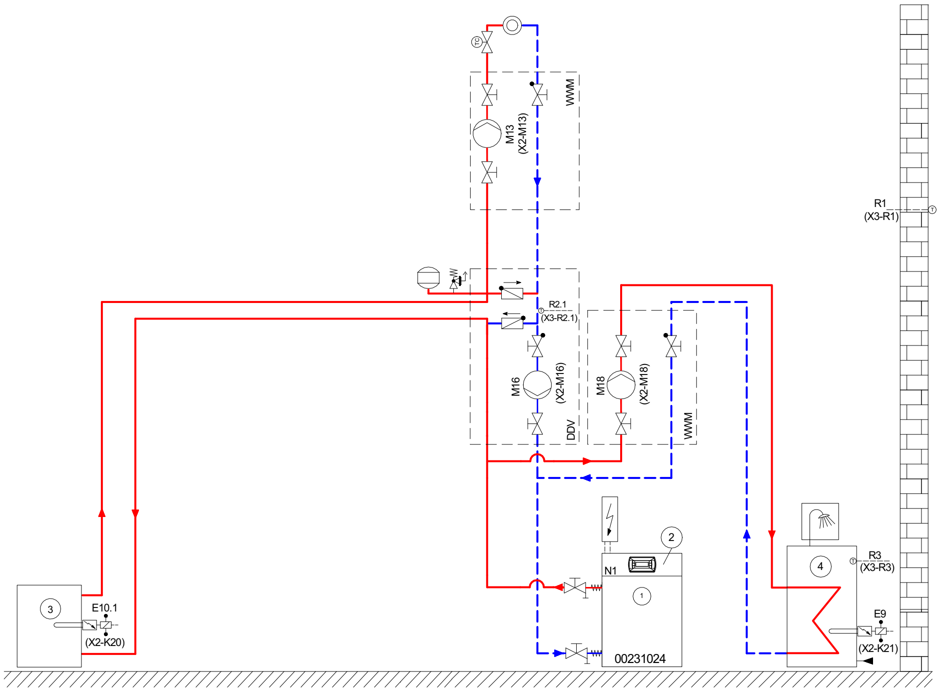


Fig. 8.41: Integration diagram for mono energy heat pump operation with one heating circuit, a buffer tank connected in series and domestic hot water heating

Pre-configuration	Setting
Operating mode electric heating	Immersion heater in the buffer
1st heating circuit	Heating
2nd heating circuit	No
Domestic hot water	Yes with a sensor
Flange heater	Yes
Swimming pool	No

The heating water flow rate must be ensured using a dual differential pressureless manifold (see Chapt. 8.4.3 on page 100)

The use of the dual differential pressureless manifold DDV 32 is recommended for heat pumps with a heating water flow rate up to max. 2.5 m^3/h.

Operation of the circulating pump (M16) in the generator circuit with the compressor in heating operation only, to avoid unnecessary operation.

Three heating circuits with differential pressureless manifold

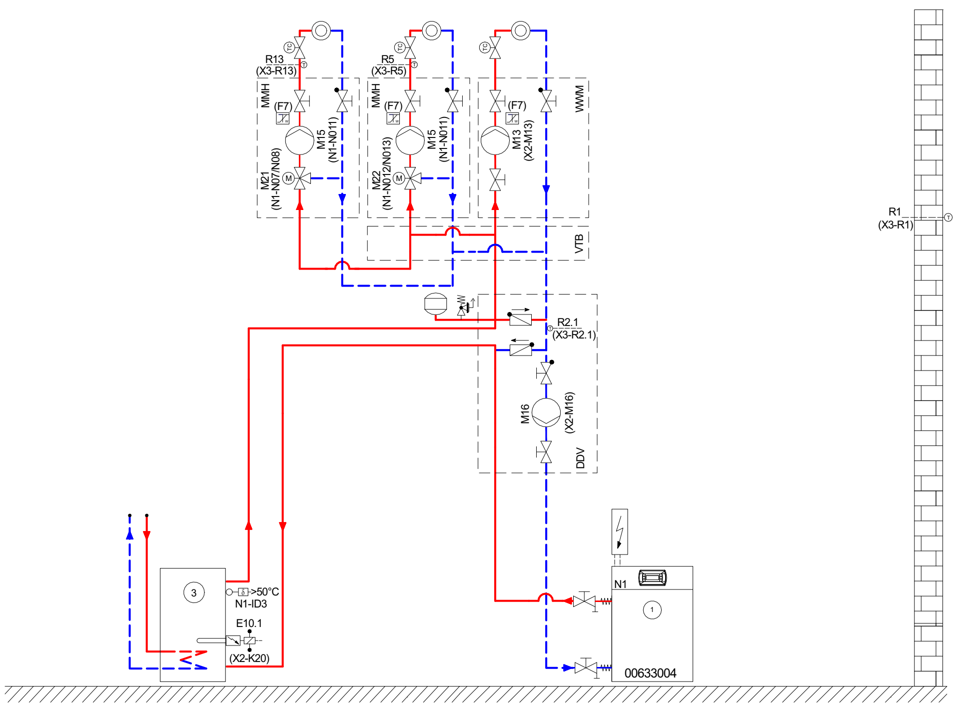


Fig. 8.42: Integration diagram for mono energy heat pump operation with three heating circuits, external supplementary heating and buffer tank connected in series

Pre-configuration	Setting
Operating mode electric heating	Immersion heater in the buffer
1st heating circuit	Heating
2nd heating circuit	Heating
3rd heating circuit	Heating
Domestic hot water	No
Swimming pool	No

A safety temperature monitor (F7) which protects the distribution system from impermissibly high temperatures must be used when the buffer tank connected in series is charged externally.

The dual differential pressureless manifold protects the heat pump since the circulating pump (M16) in the generator circuit is only active when the compressor is running in heating operation.

Heating circuit pumps M13/M15 supply the flow around the return sensor and prevent the heat pump from switching on when the system temperatures are too high.

Electrical connection of mono energy heat pump heating systems

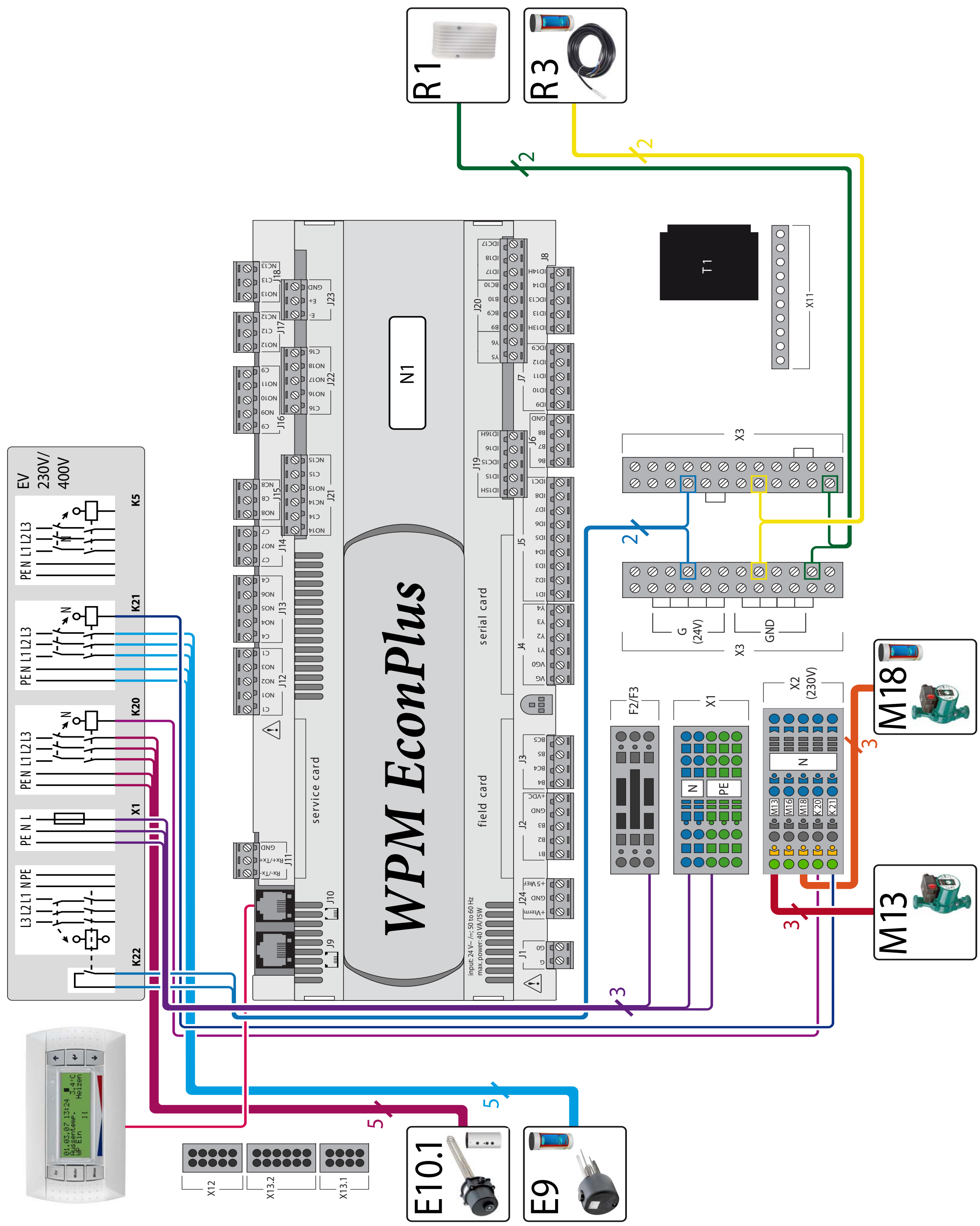


Fig. 8.43: Connection diagram of a WPM EconPlus heat pump manager with mono energy systems with one heating circuit and domestic hot water preparation

The contactor (K20) for the immersion heater (E10) of mono energy systems (HG2) should be dimensioned according to the heat output and must be supplied by the customer. It is controlled (230V AC) by the heat pump manager via terminals X1/N and J13/NO 4.

The contactor (K21) for the flange heater (E9) in the domestic hot water cylinder should be dimensioned according to the heating output and must be supplied by the customer. It is controlled (230 V AC) by the heat pump manager via the terminals X1/N and J16/NO 10.

8.15.6 Combination cylinders and combi-cylinders

Central domestic hot water preparation via tube heat exchangers

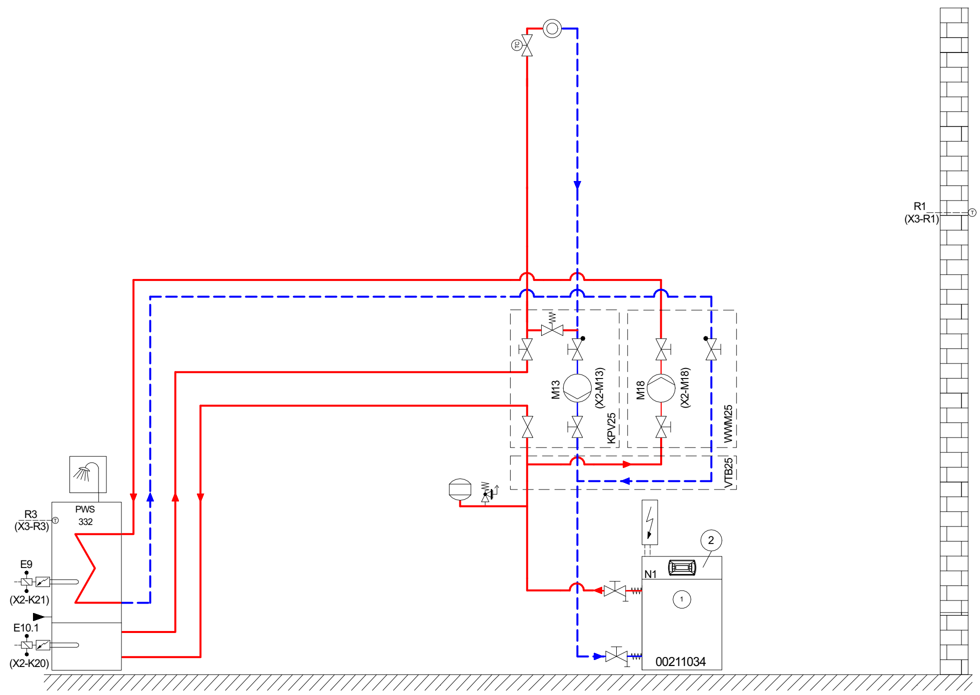


Fig. 8.44: Integration diagram for mono energy heat pump operation with one heating circuit and the PWS 332 combination cylinder

Pre-configuration	Setting
Operating mode electric heating	Immersion heater in the buffer
1st heating circuit	Heating
2nd heating circuit	No
Domestic hot water	Yes with a sensor
Flange heater	Yes
Swimming pool	No

The combination tank consists of a 100 l buffer tank and a 300 l domestic hot water cylinder which are hydraulically thermally independent of each other.

Domestic hot water is prepared using an integrated tube heat exchanger with 3.2 m^2 heat exchanger area.

Central domestic hot water preparation according to the flow principle

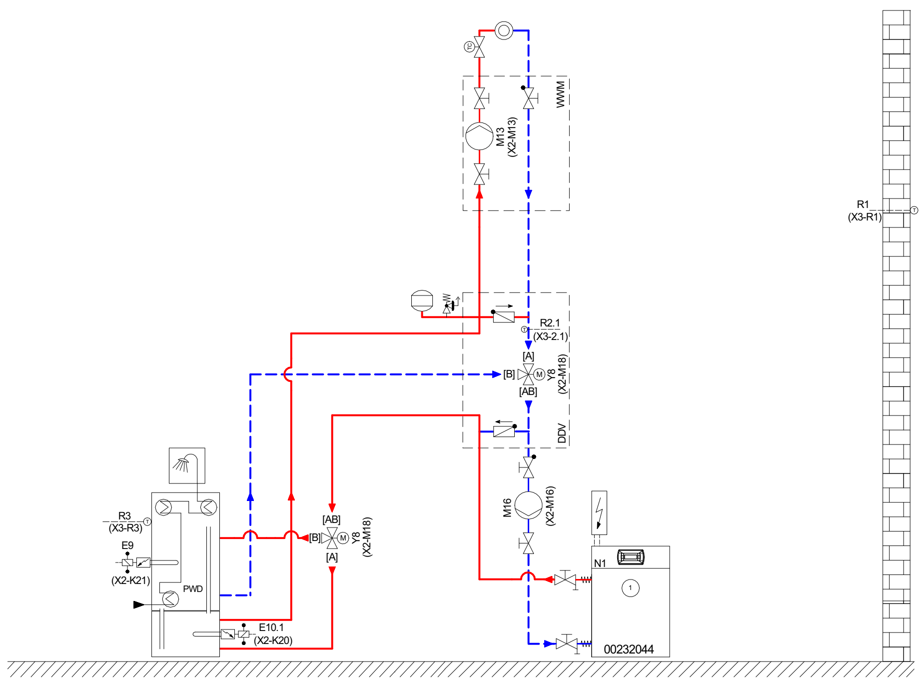


Fig. 8.45: Integration diagram for mono energy heat pump operation with two heating circuits and the combo tanks PWD 750, PWD 900 and PWD 1250.

Pre-configuration	Setting
Operating mode electric heating	Immersion heater in the buffer
1st heating circuit	Heating
2nd heating circuit	No
Domestic hot water	Yes with a sensor
Flange heater	Yes
Swimming pool	No

With the combo tanks PWD 750, 900 and 1250, the domestic hot water preparation takes place via integrated finned tube heat exchangers, which heat up the domestic hot water according to the flow principle.

Integrated heat riser pipes use the heating buffer as preheating stage for domestic hot water preparation.

A circular plate prevents the different water layers with varying temperatures from becoming mixed together.

Technical information on the combo tanks can be found in the technical appendix.

8.15.7 Bivalent heat pump heating system

Boiler for supplementary heating

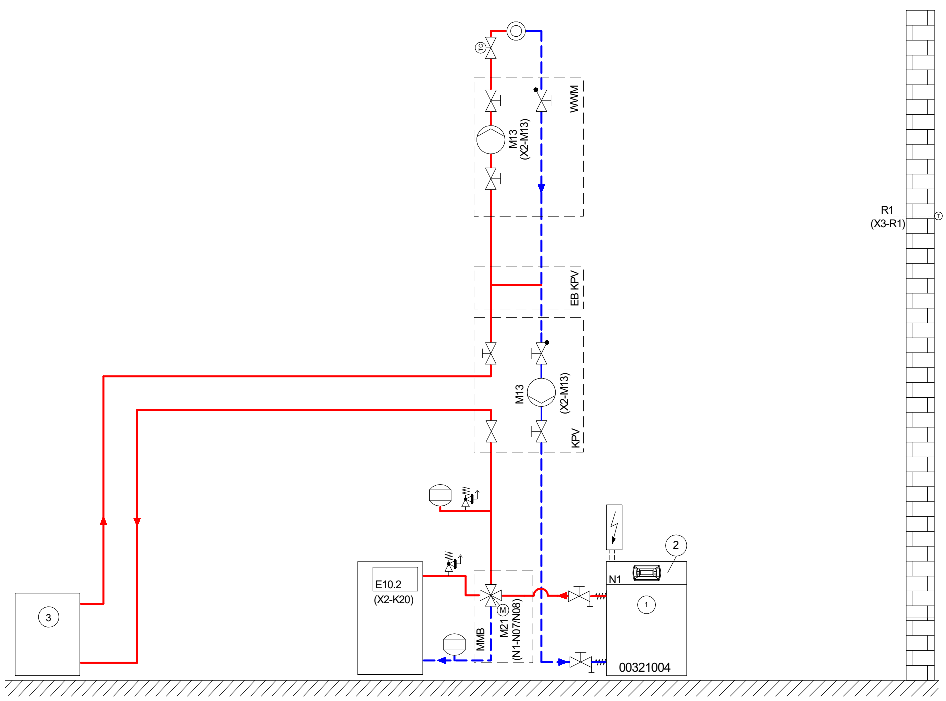


Fig. 8.46: Integration diagram for bivalent heat pump operation with a boiler, one heating circuit and a buffer tank connected in series

Pre-configuration	Setting
Operating mode	Bivalent Heat pump+ boiler
1st heating circuit	Heating
2nd heating circuit	No
Domestic hot water	No
Swimming pool	No

Regulation of the mixer (M21) is undertaken by the heat pump manager. If required, it calls for the boiler and adds more domestic hot water until the desired set return temperature is reached. From a return temperature of 65 °C, the mixer closes, thus protecting the heat pump from excessively high return temperatures.
The boiler is requested via the 2nd heat generator output of the heat pump manager. The operating mode of the second heat generator can be coded as "variable" if no domestic hot water preparation is activated.(see Chapt. 8.11.1 on page 110).

Boiler for supplementing heating and DHW preparation

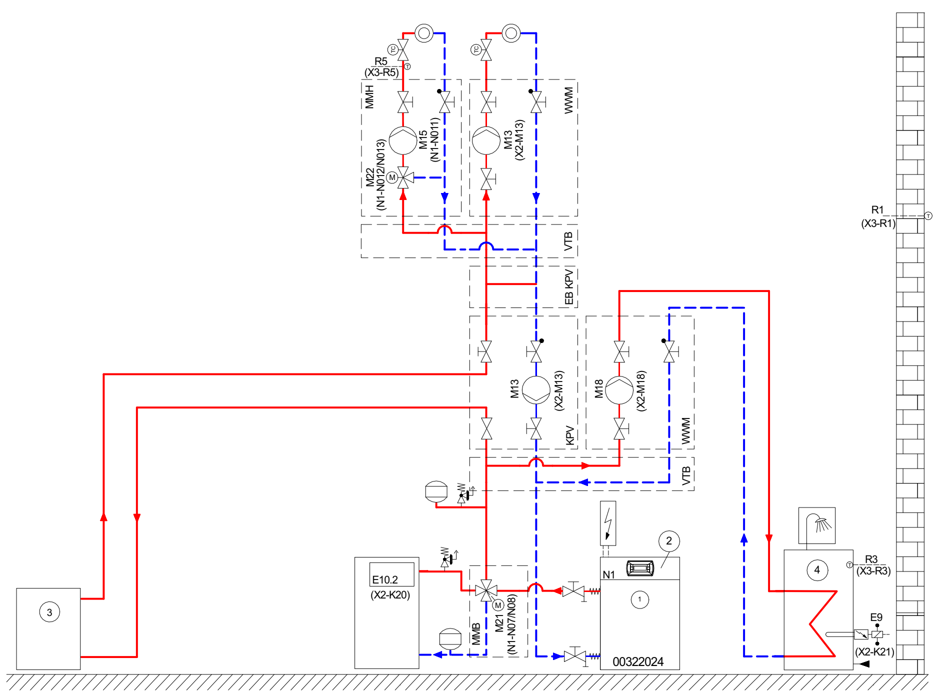


Fig. 8.47: Integration diagram for bivalent heat pump operation with a boiler, two heating circuits, a buffer tank connected in series and domestic hot water heating

Pre-configuration	Setting
Operating mode	Bivalent parallel
1st heating circuit	Yes
2nd heating circuit	Yes
3rd heating circuit	No
Domestic hot water preparation	Yes
request	Sensor
Flange heater	Yes
Swimming pool water preparation	No

The boiler can also be requested for DHW preparation to achieve higher domestic hot water temperatures. From a return temperature of 65 °C, the mixer M21 closes, thus protecting the heat pump from excessively high return temperatures.

If an additional flange heater is installed in the domestic hot water cylinder the boiler is only used for reheating and thermal disinfection when the flange heater is active in heating operation.

Electrical connection of bivalent heat pump heating systems

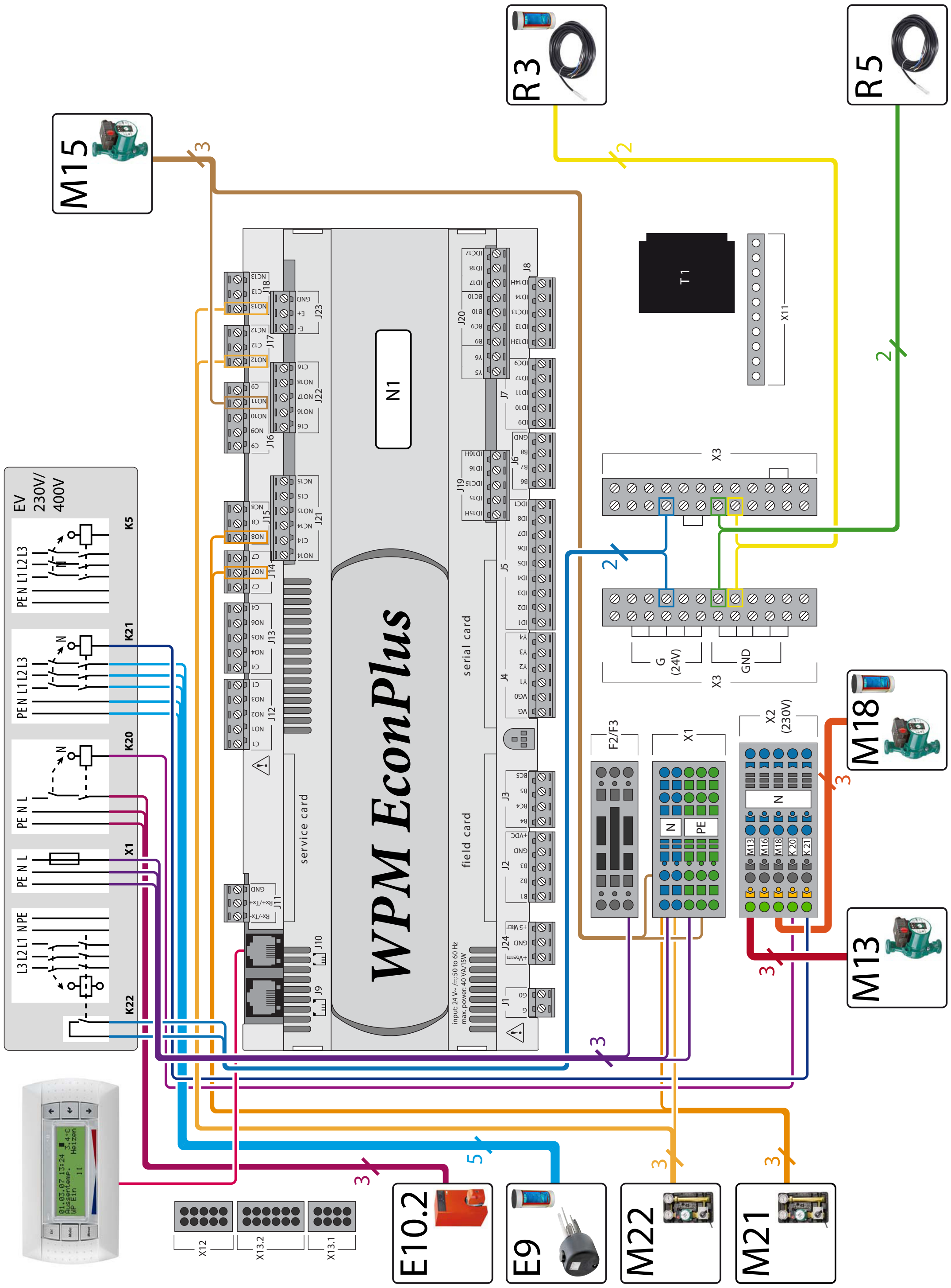


Fig. 8.48: Wiring diagram of a wall-mounted heat pump manager for bivalent systems with one heating circuit and a constant or variable regulated boiler

Constantly-regulated boiler

Regulation of the mixer is undertaken by the heat pump manager. If required, it calls for the boiler and adds more domestic hot water until the desired set return temperature or domestic hot water temperature is reached. The boiler is called via the 2nd heat generator output of the heat pump manager and the mode of operation of the 2nd heat generator is coded as being "constant".

Variably-regulated boiler

Condensing boilers can also be operated via atmospherically controlled burner regulation. If required, the boiler is called via the 2nd heat generator output, the mixer is opened fully and the full volume flow is directed via the boiler. The mode of operation of the 2nd heat generator output is coded as being “variable”. The characteristic heating curve of the burner regulation is set in accordance with the characteristic heating curve of the heat pump.

8.15.8 Integration of renewable heat sources

Solar back-up for domestic hot water preparation

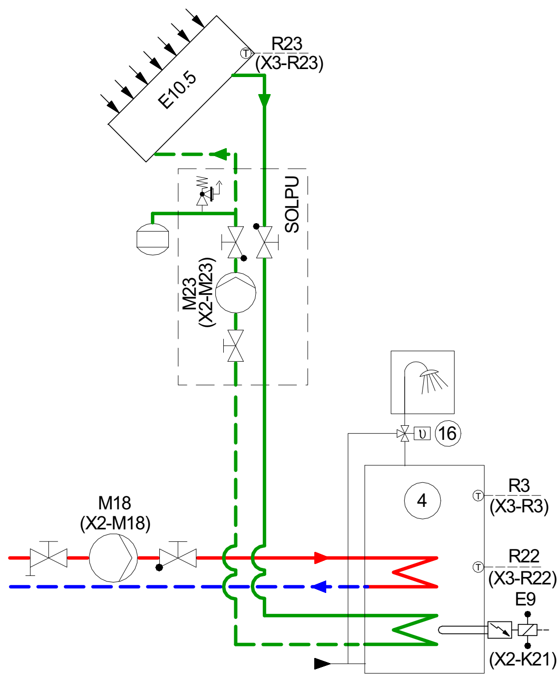


Fig. 8.49: Integration diagram (without safety valves) for a heat pump with solar back-up for domestic hot water preparation in combination with a solar station (special accessory SST 25).

The SOLPU solar station offers solar back-up for domestic hot water preparation.

Function:
The solar controller WPM Econ SOL adds solar control to the existing WPM Econ Plus heat pump manager. The solar controller WPM Econ SOL controls the circulating pump M23 in the solar station. If there is a sufficiently high temperature difference on sensor R23 and domestic hot water cylinder R22 between solar collectors (R23 > R22), domestic hot water preparation takes place via the solar collectors. Domestic hot water preparation via the heat pump only takes place if the domestic hot water set temperature is not reached on sensor R3.

External supplementary heating and solar back-up for DHW preparation

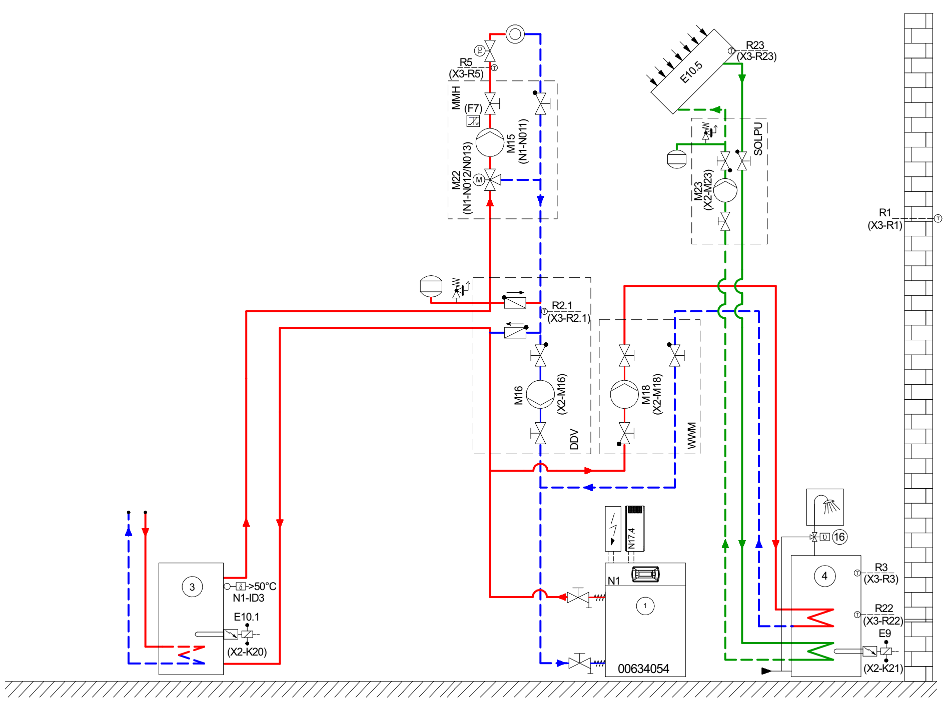


Fig. 8.50: Integration diagram for mono energy heat pump operation, one heating circuit, series-connected buffer tank with external supplementary heating and domestic hot water preparation (hydraulics only suitable for brine-to-water or water-to-water heat pumps)

Pre-configuration	Setting
Operating mode electric heating	Immersion heater in the buffer
1st heating circuit	Heating
2nd heating circuit	Heating
3rd heating circuit	No
Domestic hot water	yes via sensor
Flange heater	Yes
Swimming pool	No

Supplementary heating
The return sensor must be mounted in exactly the position shown to prevent the heat pump from switching on when the cylinder is charged.
The universal buffer tank PSW 500has a flange connection for installing the solar heat exchanger RWT 500. A safety temperature monitor must be used with panel heating systems (Chapt. 8.6.4 on page 107)

With permanent charging temperatures of over 50 °C, the heat pump must be blocked via an additional thermostat for domestic hot water and swimming pool water preparation (ID3).

Renewable back-up for heating and domestic hot water preparation

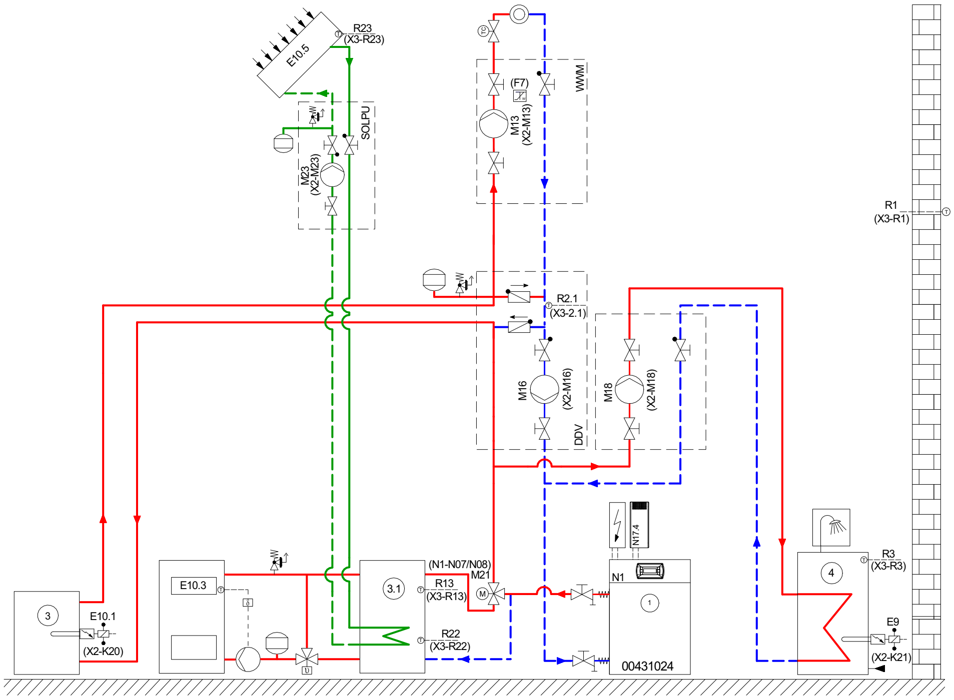


Fig. 8.51: Integration diagram for bivalent renewable heat pump operation of a solid fuel boiler with renewable cylinder, a heating circuit with buffer tank connected in series and domestic hot water preparation

Pre-configuration	Setting
Operating mode	bivalent renewable
electric heating	immersion heater in the buffer
Solar control	Yes
1st heating circuit	Heating
2nd heating circuit	No
Domestic hot water	Yes with a sensor
Flange heater	Yes
Swimming pool	No

The renewable cylinder (3.1) is loaded by either the solid fuel boiler or by additional heat generators (e.g. solar , see Solar thermal energy manual). The buffer volume must be dimensioned according to the information from the solid fuel boiler manufacturer.

With a sufficiently high temperature level in the renewable cylinder the heat pump is blocked and the energy from the cylinder is used for heating requests, domestic hot water requirements and swimming pool needs.

Renewable back-up for heating and domestic hot water preparation

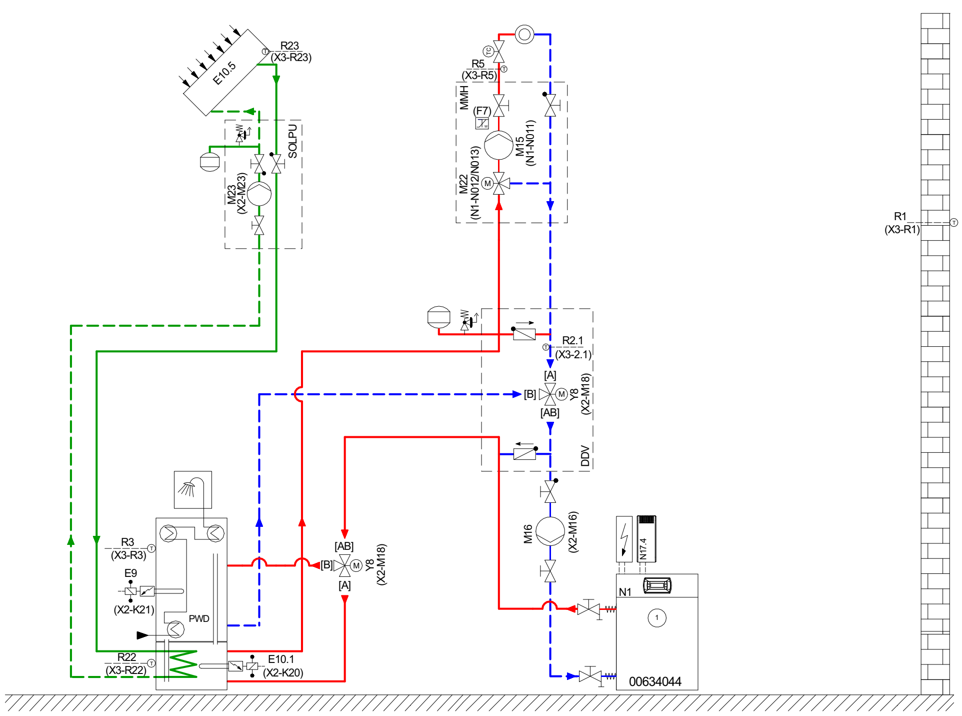


Fig. 8.52: Integration diagram for mono energy heat pump operation with PWD 750 combo tank for external supplementary heating and domestic hot water preparation.

Pre-configuration	Setting
Operating mode	Mono energy Heat pump+ electric heating
1st heating circuit	Heating
2nd heating circuit	Heating
3rd heating circuit	No
Domestic hot water	Yes with a sensor
Flange heater	Yes
Swimming pool	No

A separating plate integrated into the combo tank in combination with a 3-way valve prevents mixing losses between the heating and the domestic hot water zones. With external charging, heat riser pipes distribute the external energy to the supplementary heating system and the domestic hot water preparation on the basis of the temperature.

A flange connection enables the solarheat exchanger RWT 750 to be installed.

The heating circuit pump M15 supplies the flow around the return sensor and prevents the heat pump from switching on when the system temperatures are too high.

Renewable back-up via a combo tank

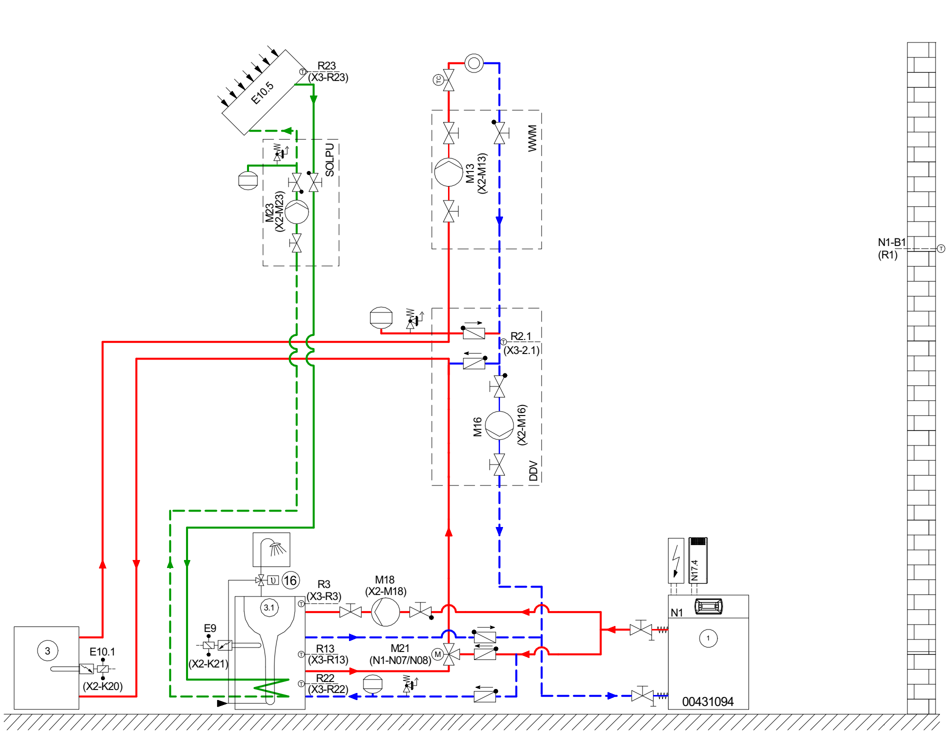


Fig. 8.53: Integration diagram for heat pump for bivalent renewable heat pump operation with external back-up domestic hot water preparation and heating using a combo tank without separating plate

Pre-configuration	Setting
Operating mode electric heating	Immersion heater in the buffer
1st heating circuit	Heating
2nd heating circuit	No
Domestic hot water	Yes
Flange heater	No
Swimming pool	No

Note:
The possible domestic hot water temperatures depend largely on the design of the combo tank. On combo tanks without a separating plate, the additional buffer tank (3) guarantees the defrosting function with air-to-water heat pumps.
A sensor in the bottom section of the combo tank blocks the heat pump when it is fully loaded and activates the mixer regulation.
The water in the combo tank is heated by solar energy and is also used for supplementary heating (see also Chapt. 8.11.3 on page 111).

8.15.9 Swimming pool water preparation

Heating, domestic hot water and swimming pool water preparation

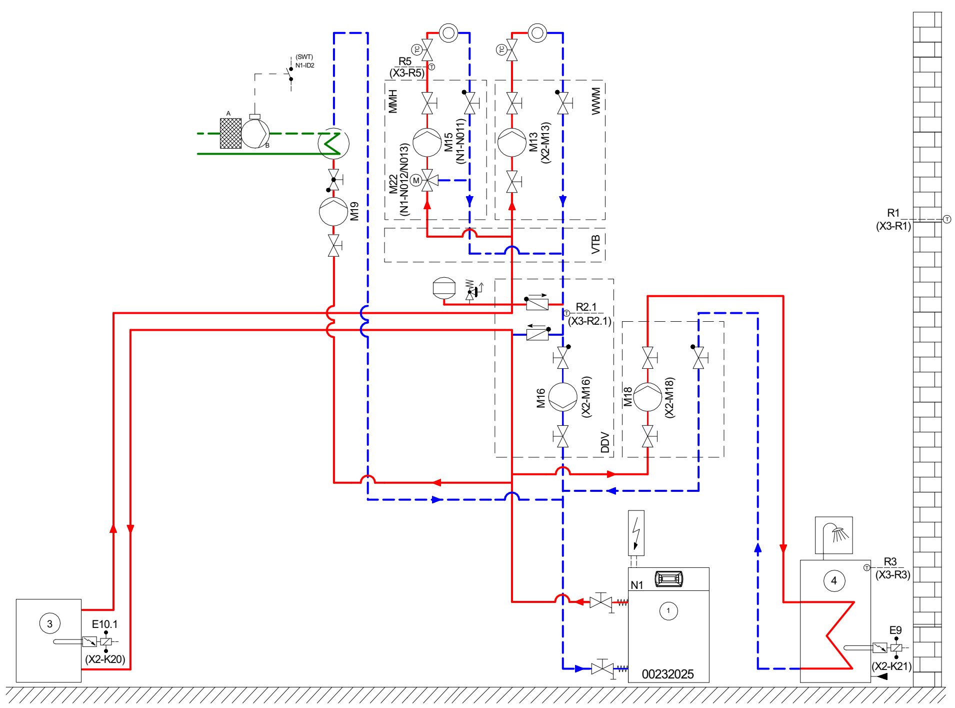


Fig. 8.54: Integration diagram for mono energy heat pump operation with two heating circuits, domestic hot water and swimming pool water preparation

Pre-configuration	Setting
Operating mode electric heating	Immersion heater in the buffer
1st heating circuit	Heating
2nd heating circuit	Heating
3rd heating circuit	No
Domestic hot water	Yes
Flange heater	Yes
Swimming pool	Yes

Order of priority:
Domestic hot water preparation has priority over heating and swimming pool preparation (see Chapt. 8.12 on page 111)

A request for swimming pool water comes in via input ID2.

8.15.10 parallel connection of heat pumps

Dual differential pressureless manifold

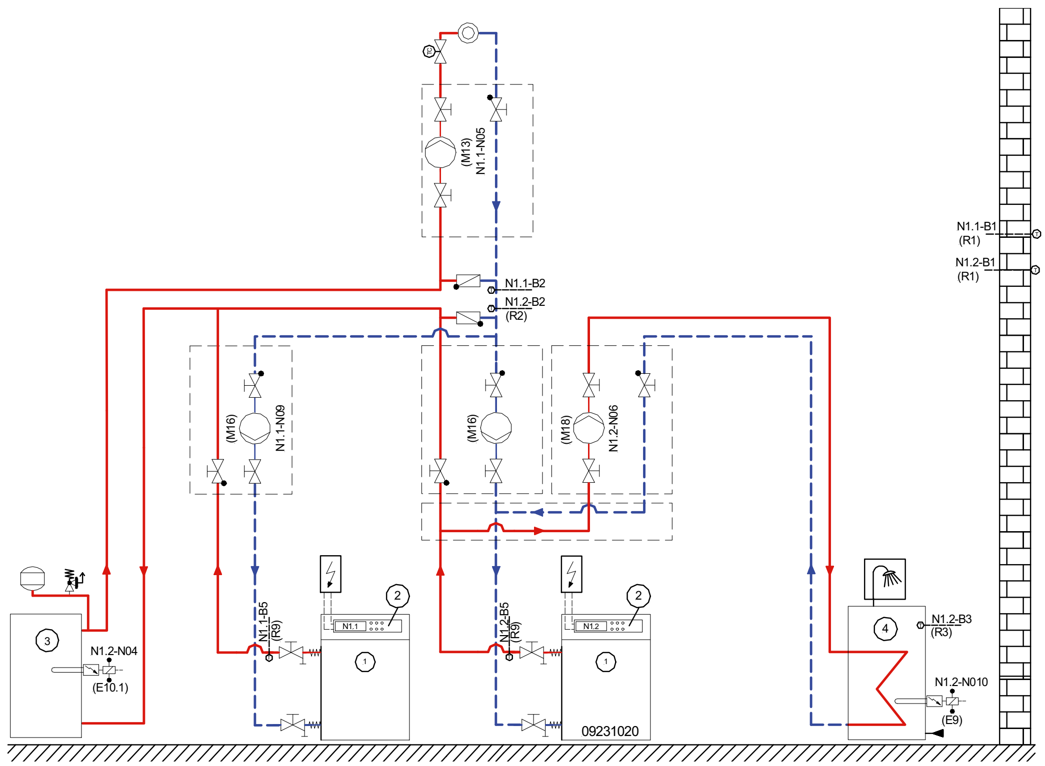


Fig. 8.55: Integration diagram for heat pumps connected in parallel, a buffer tank connected in series with two manifolds without differential pressure and domestic hot water preparation

Pre-configuration	Setting	
Heat pump	1.1	1.2
Operating mode pipe heating	None	Immersion heater in the buffer
1st heating circuit	Heating	Heating
2nd heating circuit	No	Domestic hot water
Domestic hot water	No	yes via sensor
Swimming pool	No	No

Domestic hot water preparation is carried out by the heat pump only.

With brine-to-water heat pumps each heat pump has its own brine circulating pump. A joint borehole heat exchanger or ground heat collector system is used as a heat source.

parallel connection of heat pumps

A higher heat or cooling requirement can be met by connecting heat pumps in parallel.

A parallel connection of heat pumps is possible **without a higher-level regulation** by the existing heat pump managers:

- The same heating curves are set for all heat pump managers
- Using the "Warmer" and "Colder" arrow buttons, heat pumps which are additionally used for domestic hot water and swimming pool water preparation should be set in such a way that the return set temperature is 1 K lower.
- In systems with swimming pool water preparation, the return sensor in the heating circuit must be switched to an additional sensor in the swimming pool circuit during swimming pool water preparation.

A **higher-level load management** is normally used for the following requirements:

- Combination of different heat sources
- Individual power control with adjustable compressor switch-on and/or switch-off times
- Central domestic hot water preparation via all heat pumps connected in parallel

Performance level	Contact position
0 = heat pump off	ID1 open ID2 open
1 = heat pump on with 1 compressor	ID1 closed ID2 open
2 = heat pump on with 2 compressors and 2nd heat generator	ID1 open ID2 closed

Planning for parallel connection

On request, Dimplex offers the following services (to be charged as planning services) for the cascading of heat pumps with special requirements placed on the regulation system:

Creation of a regulation concept with specification of the hydraulic integration for parallel connection of Dimplex heat pump systems for heating and cooling with a maximum of 14 heat pumps.

8.15.11 Integration of split air-to-water heat pumps

Mono energy operation

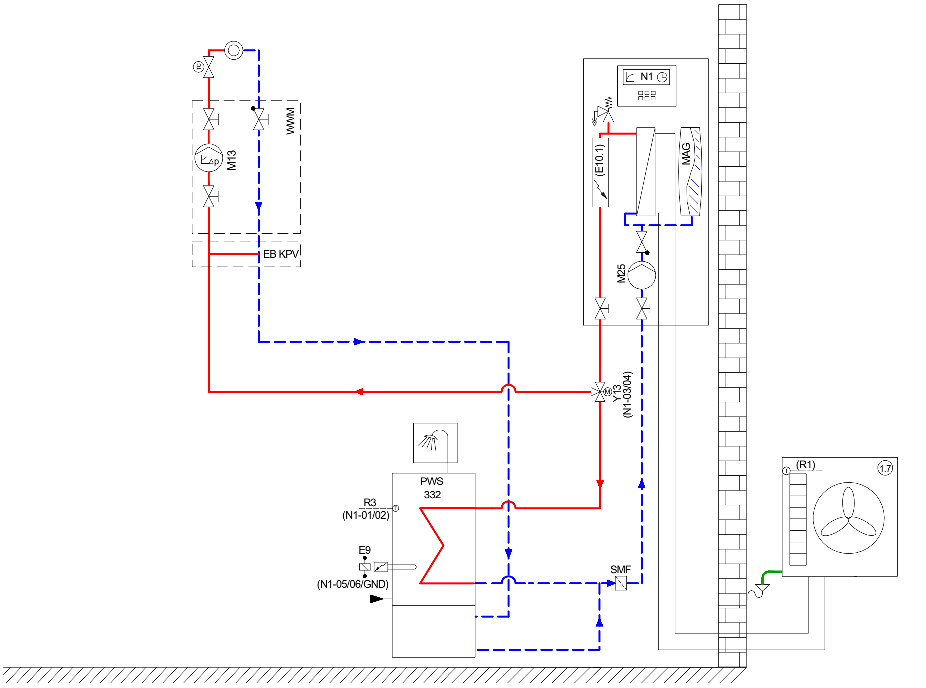


Fig. 8.56: Integration diagram for monovalent heat pump operation of a split air-to-water heat pump with one heating circuit and domestic hot water preparation (regulation based on outside temperature)

With all split air-to-water heat pumps, the indoor unit contains an electric heating element for supplementary heating and a circulating pump. The heating element supports the heat pump when needed. Via the three-way valve, the circulating pump either acts as a heat circulating pump or a domestic hot water circulating pump.

The circulating pump M13 installed in the heating circuit is an electronically regulated circulating pump.

Bivalent operation

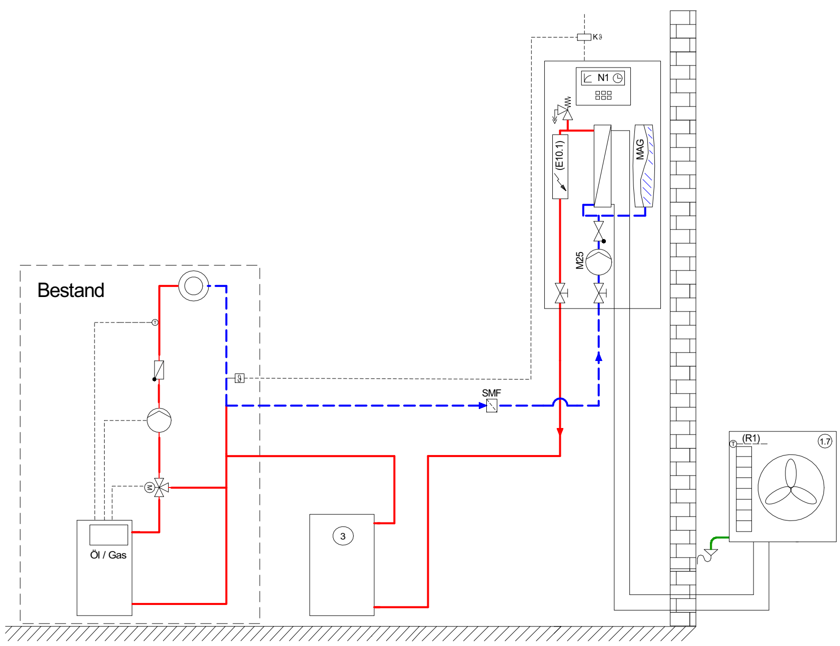


Fig. 8.57: Integration diagram for bivalent heat pump operation of a split air-to-water heat pump with one heating circuit and an existing boiler (oil/gas)

The system marked as an existing system is controlled via the existing boiler controller. The maximum inlet temperature in the heat pump must be restricted to 60°C.(e.g. with the thermostat shown).

If the bivalent alternative operating mode is required, the heat pump can be switched off via the thermostat shown if the temperature is exceeded. The bivalence point of the heat pump must be set to -15 °C to prevent the installed pipe heater from switching on. The heating curve of the heat pump must also be set so that there is a higher set temperature above the bivalence point than with the boiler controller. Domestic hot water preparation via the heat pump and boiler is not possible with this integration.

9 Online Operating Cost Calculator

The operating cost calculator is an effective online tool for designing a heat pump heating system and for determining the operating costs and the seasonal performance factor according to VDI 4650.

The online tool is divided into 9 steps.

Steps 1-5 comprise the design process of the heat pump heating system.

Step 6 is the calculation of the seasonal performance factor and the creation of the calculation sheet.

In steps 7-9, the investment and operating costs of different heat generators can be compared.

i NOTE

The operating cost calculator can be found online at www.dimplex.de/betriebskostenrechner

Designing the heat pump heating system

The step-by-step design of the operating cost calculator provides information on the most important heat pump heating system parameters.

Heat pump design

1. Step: Input of the key building data for the rough design of the heat pump

This refers to the building itself. The following information is important here:

- Which areas are heated?
- Where is the building located?
- Which distribution system is used in the building and which flow temperatures are set?
- How does the building envelope look?
- Have any insulation measures been carried out?

2. Step: Input of the calculated heat load or estimate based on the consumption

The heat load is the most important criterion when selecting a suitable heat pump. It can be entered directly in step 2 when a heat load calculation according to EN 12831 has been carried out. Alternatively, the heat load can be estimated based on the current oil and gas consumption.

3. Step: Selection of the heat source, information on domestic hot water and utility company shut-off times

An additional energy demand must be added to the heat pump output for possible utility company shut-off times and for domestic hot water preparation. The necessary data are entered in step 3.

4. Step: Selection of the operating mode

The operating mode is selected depending on the energy source selected in step 3. Air-to-water heat pumps are normally operated in mono energy mode, i.e. in addition to the heat pump, supplementary heating is also operated with electricity. The bivalence point determines the outside temperature at which the supplementary heating is switched on.

Brine-to-water and water-to-water heat pumps are normally operated in monovalent mode. This means that the heat pump alone is used for heating.

A ground heat collector can also be dimensioned with brine-to-water heat pumps in Germany. For this, the post code of the relevant region and the ground type must be entered in this step. This enables the maximum abstraction capacity for the relevant ground type to be determined via a database.

In bivalent operating mode, the heat pump is operated in combination with a second heat generator which uses a different energy source, e.g. oil or gas.

5. Step: Information for calculating the seasonal performance factor

The system parameters, such as the heating flow and return temperature, spread and brine inlet temperature, can be adapted here for calculating the seasonal performance factor. For brine-to-water and water-to-water heat pumps, the power consumption of the brine circulating pump or well pump can also be specified here, as this is also included in the seasonal performance factor.

6. Step: Selection of the heat pump

A suitable heat pump can now be selected here. The overview shows all suitable heat pumps with the expected seasonal performance factor. Different information can be called up here for each heat pump:

- PDF document with all relevant data for calculating the seasonal performance factor
- PDF document with all information required for filling out a BAFA funding application
- Diagram showing the operating limits of the heat pump

Step 7- 9: Operating costs

In steps 7 and 8 of the operating cost calculator, the operating costs of different heat generators and the heat pump heating system can be calculated.

The overall operating costs (including investment costs) for different systems can be compared in step 9.

10 Help with planning and installation

10.1 Pipework dimensioner

In order to minimise the pressure drops and thus the power consumption of the circulating pumps, the pipe cross sections must be dimensioned accordingly. The specific pressure drop per pipe meter and the flow velocity of the medium in the pipe – both based on the nominal volume flow – are used as designing criteria.

The following guideline values should not be exceeded:

- dpmax = 120 Pa/m
- from pipework DN 10 to DN 65 wmax = 0.7 m/s
- from pipework DN 80 to DN 125 wmax = 1.2 m/s
- from pipework DN 150 wmax = 2.0 m/s

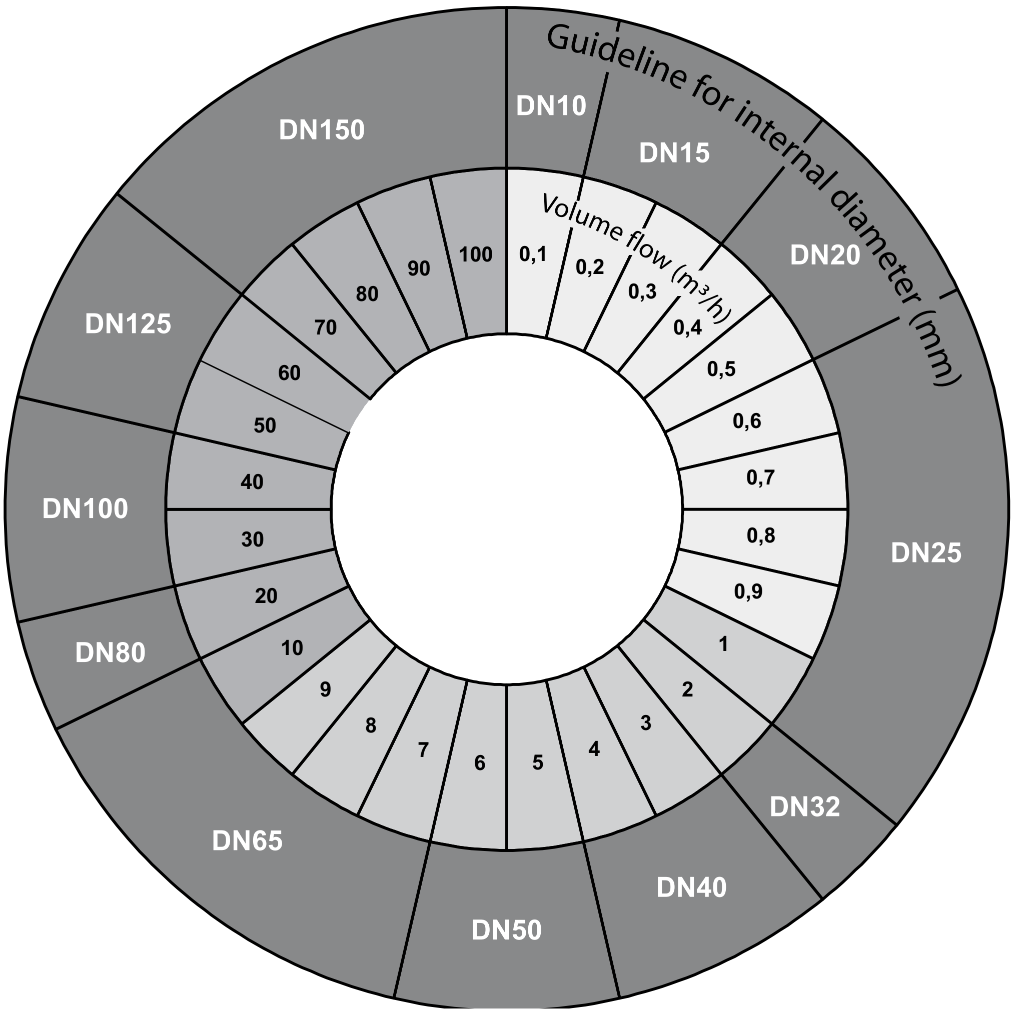


Fig. 10.1: Dimplex pipework dimensioner

ATTENTION!

The approximate pipework dimension can be determined using the diagram. The approximate values do not replace a pipework network calculation. The pressure drop determined in the pipework calculation are required in addition to the circulating pump design.

NOTE

The pressure drop in the system is increased when water-glycol mixtures are used. This must be taken into account in the pump design.

NOTE

When using composite pipes, higher pressure drops must be taken into consideration due to the significantly reduced cross-sections on the moulded parts. For pipework sections with a large number of moulded parts, a pipework diameter with at least one dimension larger must be selected. The pressure drop should also be kept as low as possible when designing additional pipework components (check valves, two and three-way reversing valves).

NOTE

Special planning instructions for efficient heat pump system operation and the Dimplex pipework dimensioner are available to download at www.dimplex.de/professional/online-planer/hydraulische-einbindungen.

10.2 Template for experimental determination of the actually required system temperature

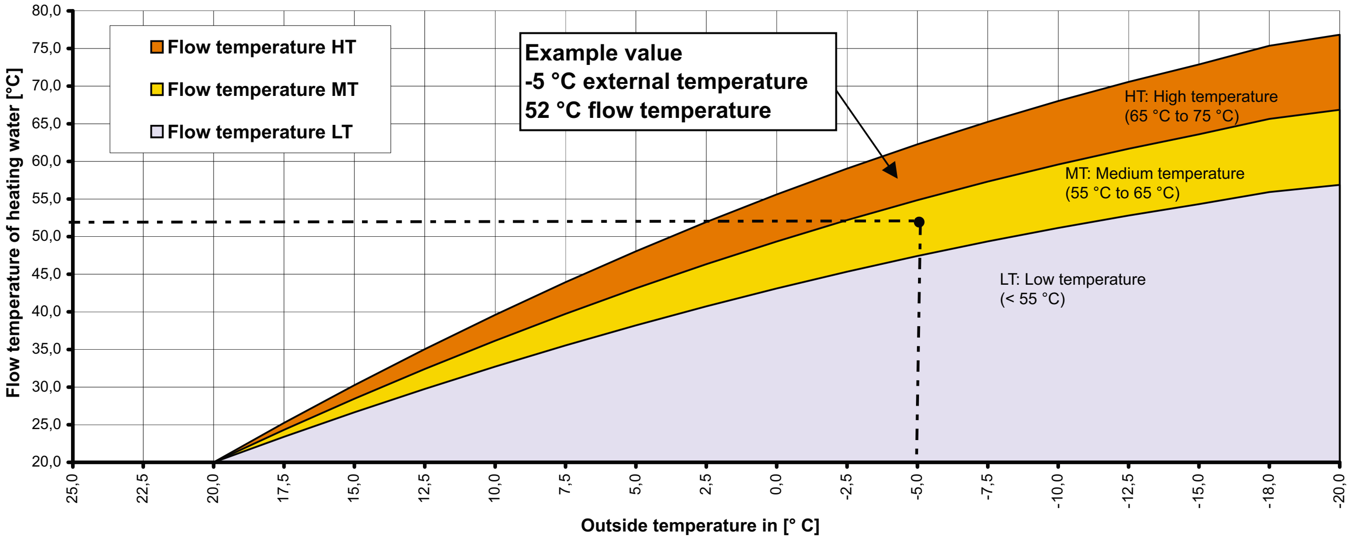


Fig. 10.2: Diagram for experimental determination of the actually required system temperature

Measured values	Example	1	2	3	4	5	6	7	8	9
Outside temperature	-5 °C									
Flow temperature	52 °C									
Return temperature	42 °C									
Temperature difference	10 °C									

Carry out the following steps during the heating period at different outside temperatures:

1. Step: Set the thermostats in rooms with high heat consumption (e.g. bathroom and living room) to the highest level (valve fully open!).

2. Step: Reduce the flow temperature at the boiler or at the mixer valve until the desired room temperature of approx. 20-22 °C is reached (note: take the sluggishness of the heating system into consideration!)

3. Step: Enter the flow and return temperatures and the outside temperature in the table.

4. Step: Transfer the measured values to the diagram.

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INNOVATIVE HEATING AND COOLING

Glen Dimplex Deutschland GmbH
Dimplex Division
Am Goldenen Feld 18
95326 Kulmbach, Germany
Phone: +49 9221 709-201
Fax: +49 9221 709-233
09221709233@dimplex.de
www.dimplex.de